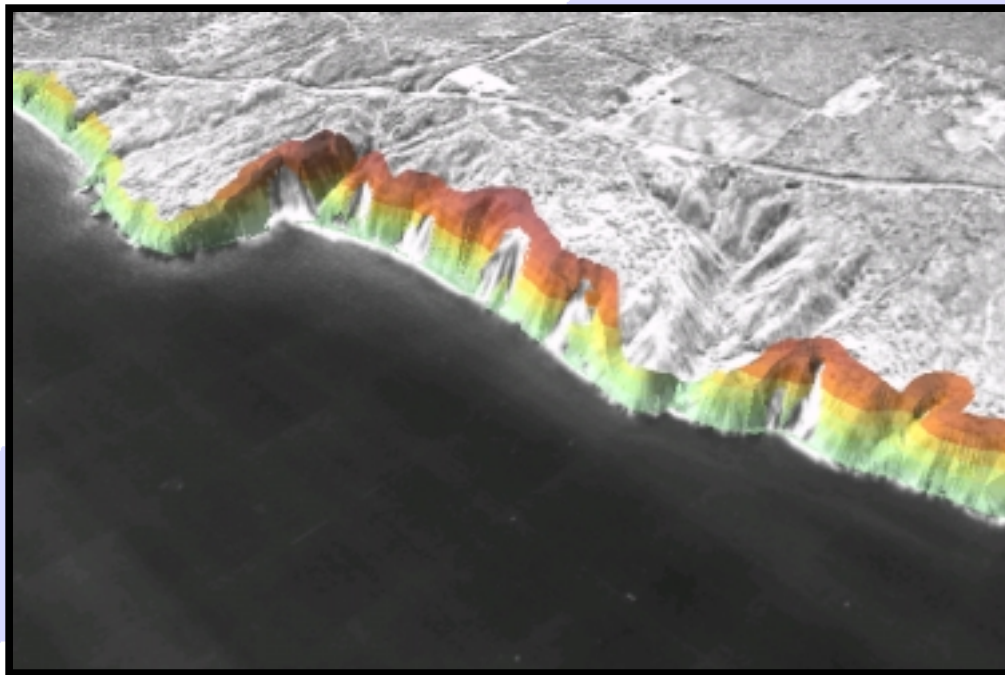
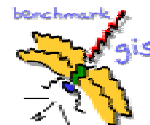


Lake Superior Shoreline Recession Analysis using Historic Aerial Photography



Mark Miller
Benchmark GIS



Funded by
 WISCONSIN COASTAL
MANAGEMENT PROGRAM





Presentation Goals

- Overview of study
- Recession analysis and visualizations
- Web-based resources



Coastal Land Ownership in Bayfield County

- 114 miles of Lake Superior shoreline
- More than 1200 parcels situated along the lake (1% of land area)
- Small parcel sizes (6.2 acres) along shore
- Account for 5% of total number of private parcels
- Account for 10% of total private land value in county
- Some extend less than 150' from existing shoreline

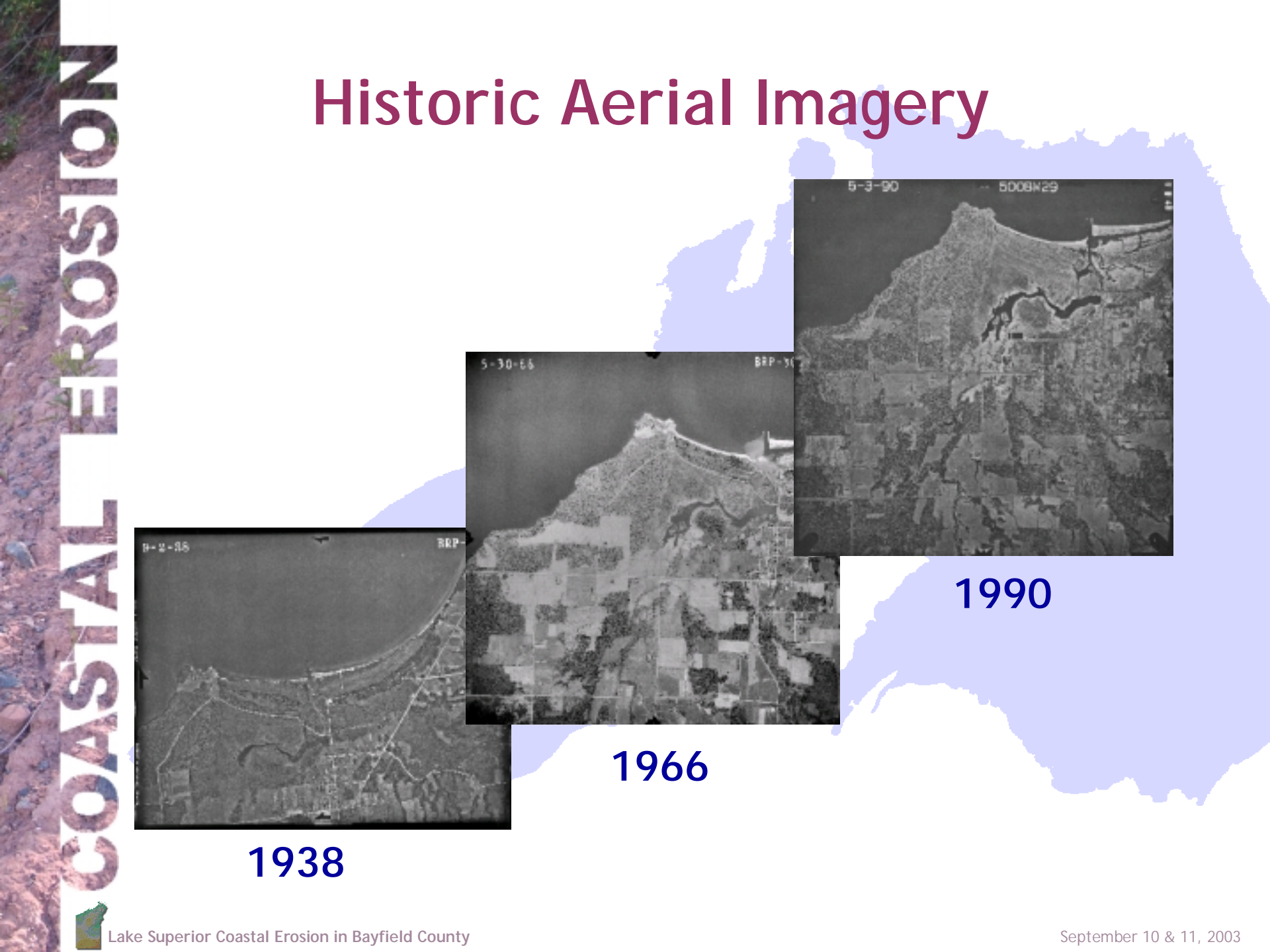


Related Studies

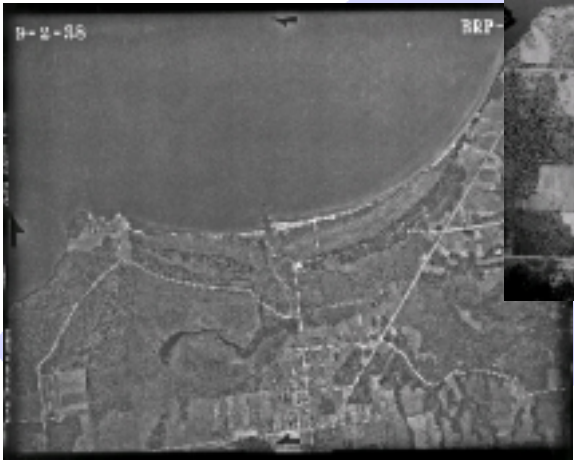
Whittlesey Creek Watershed

- Analysis of current and historic aerial photography
- Use of sophisticated mapping tools to compare multi-year terrain models

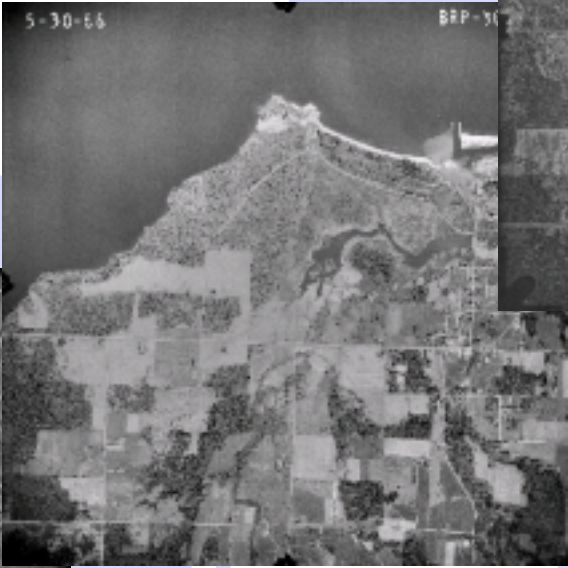




Historic Aerial Imagery



1938



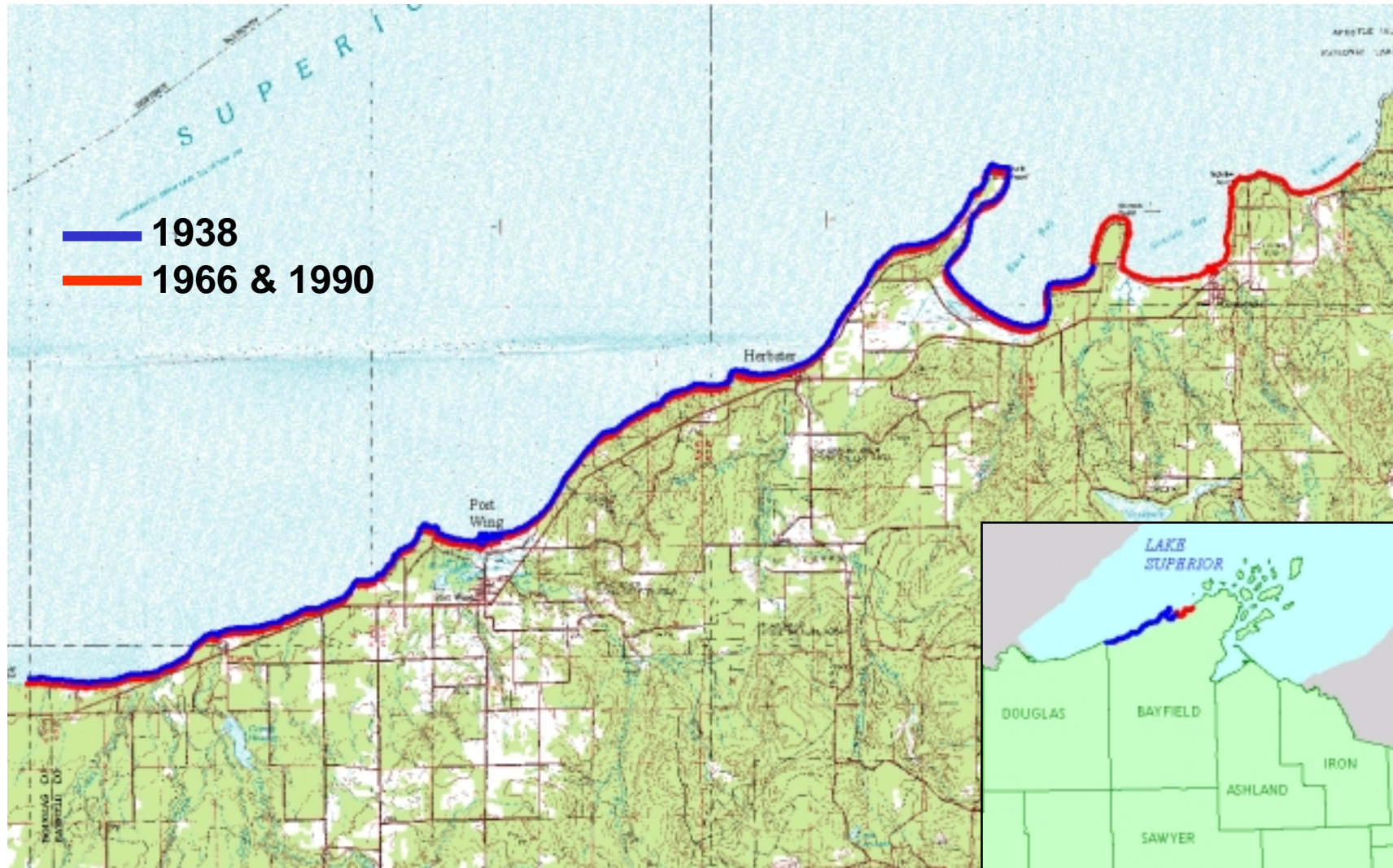
1966



1990



Study Area



Photogrammetric Principals

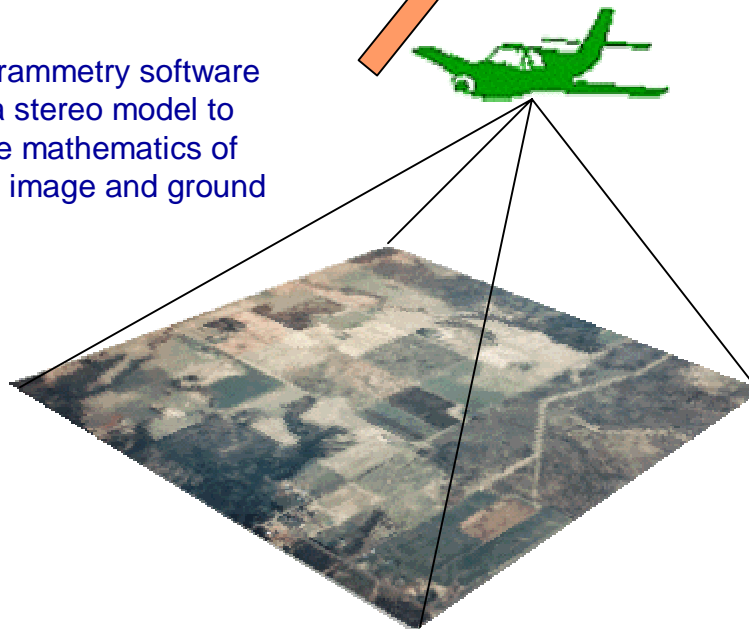


Picking photo fiducials and entering camera calibration provides *interior orientation*

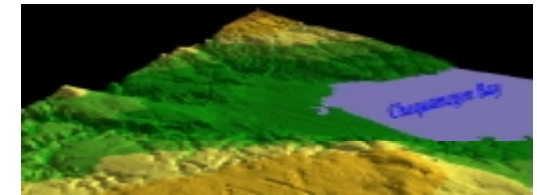


Correlating photo features with actual ground coordinates captured using GPS provides *exterior orientation*

Photogrammetry software builds a stereo model to recreate mathematics of sensor, image and ground



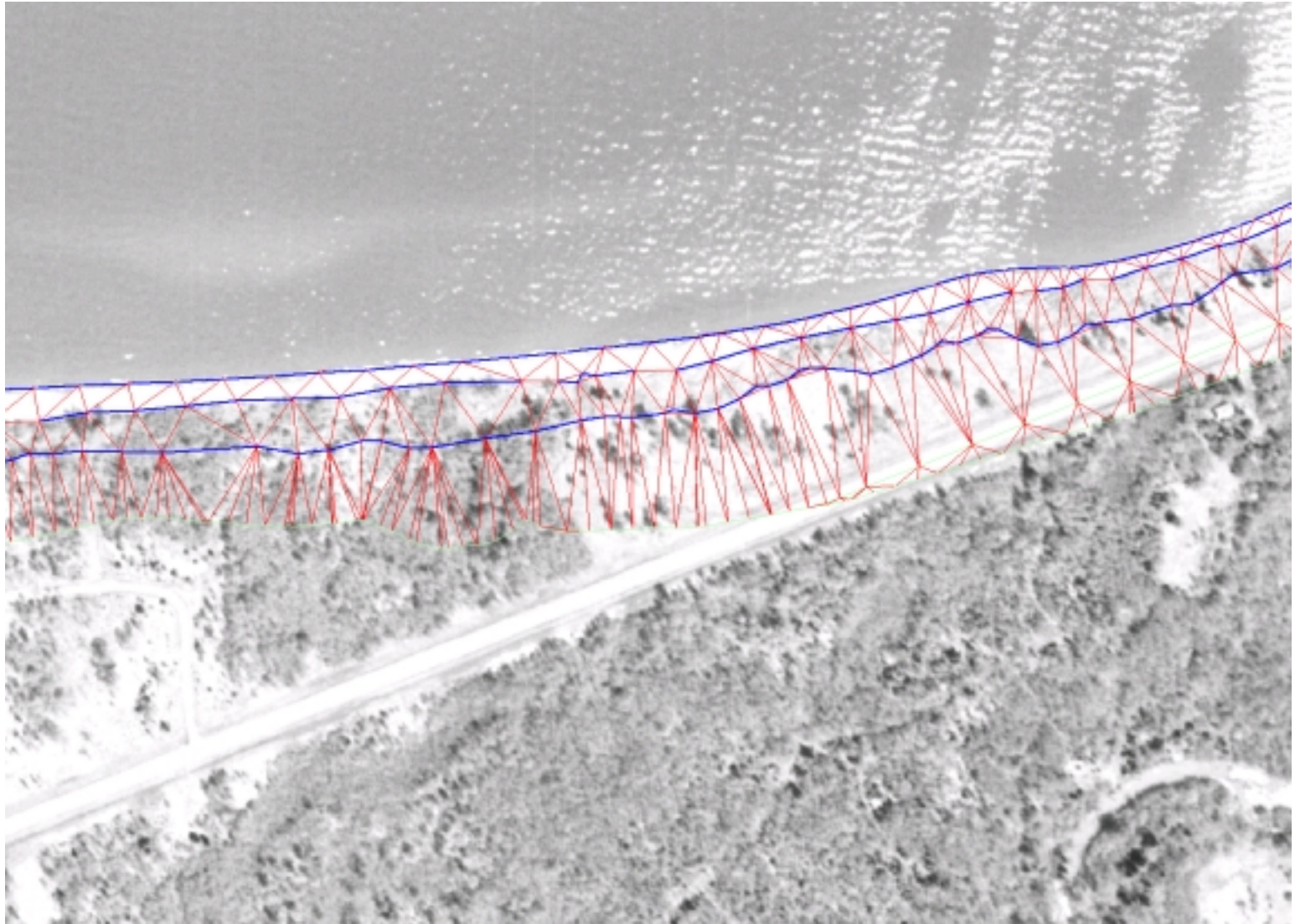
Terrain models are used to model and remove elevation distortion



Stereo model and terrain model combine with original imagery to create orthophoto.



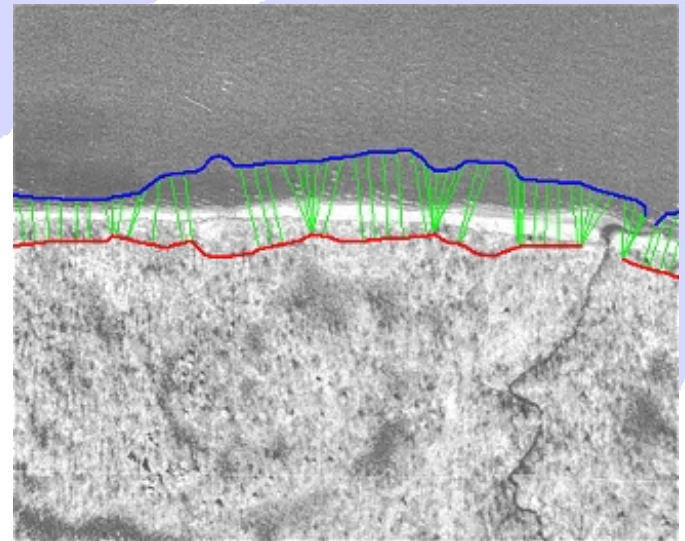
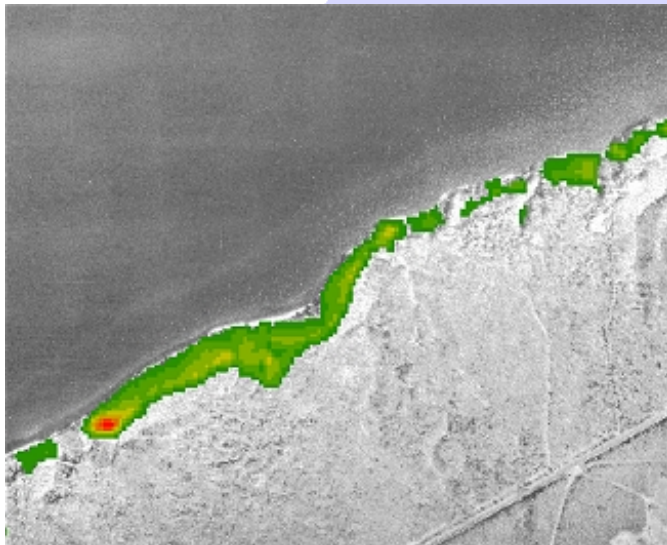
3D Shoreline Delineation

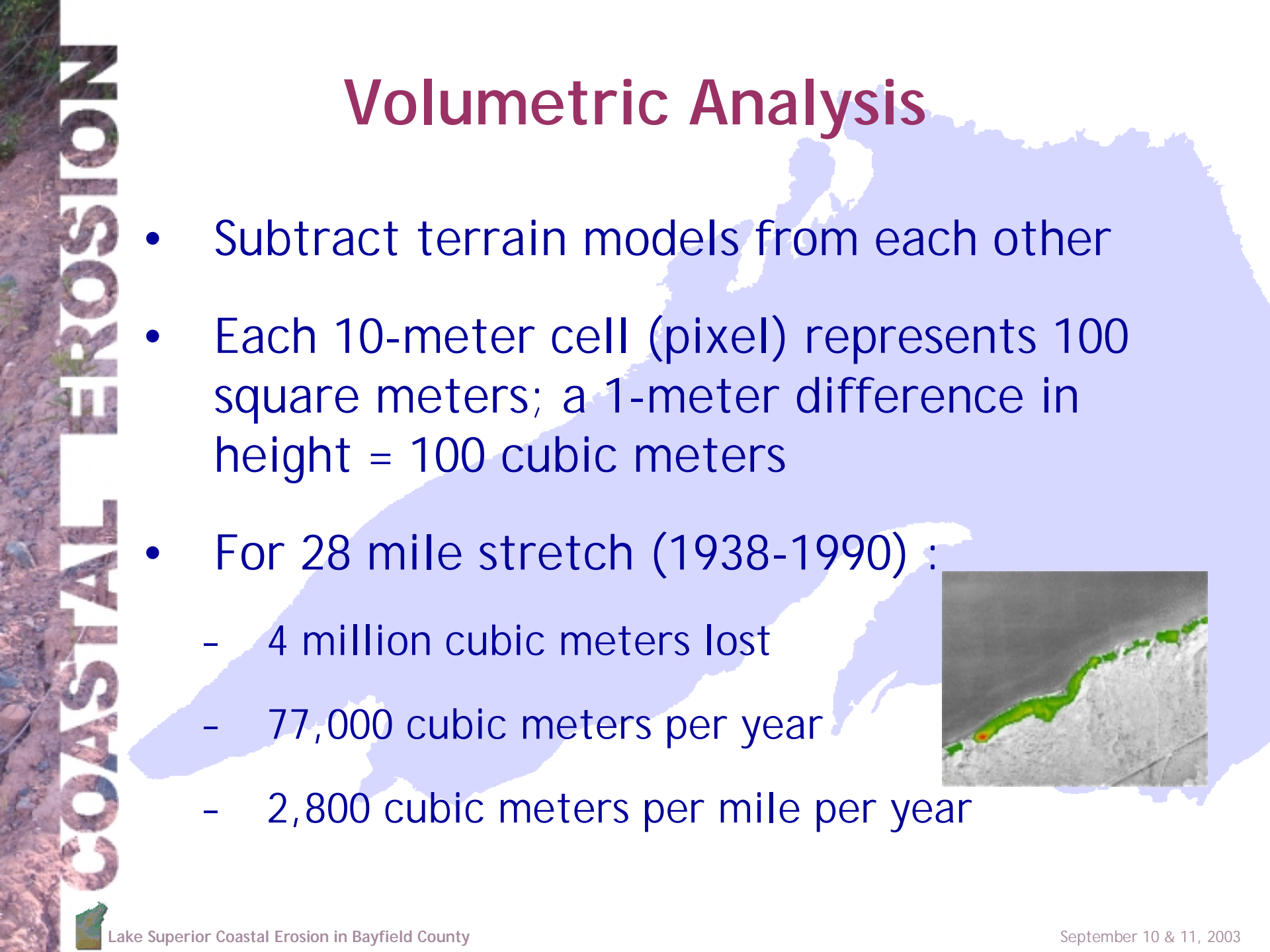


Analysis

Two analyses performed to evaluate the potential of derived products:

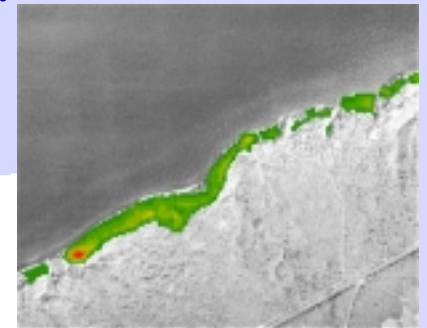
- Volumetric analysis
- Ridge recession analysis

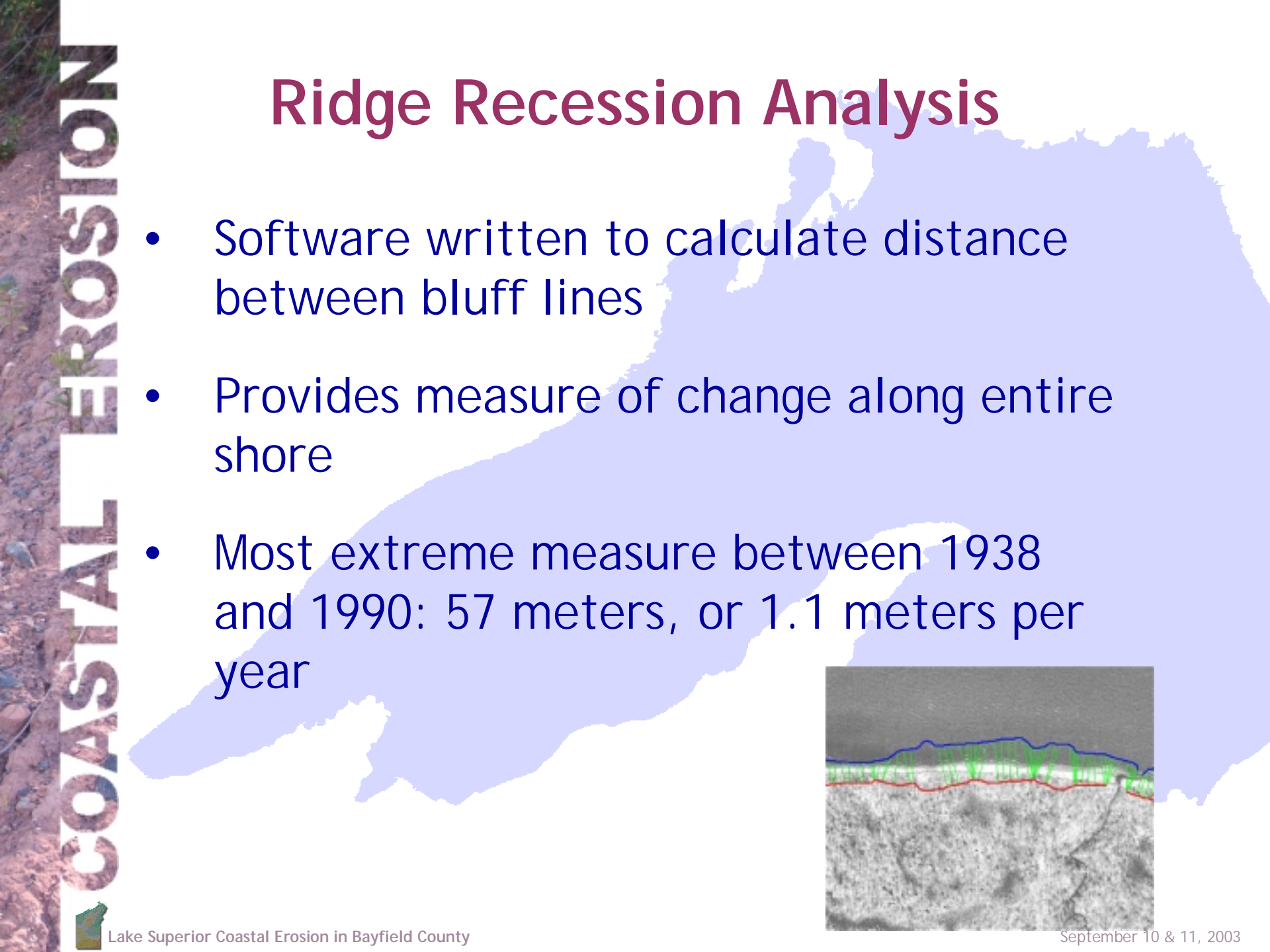




Volumetric Analysis

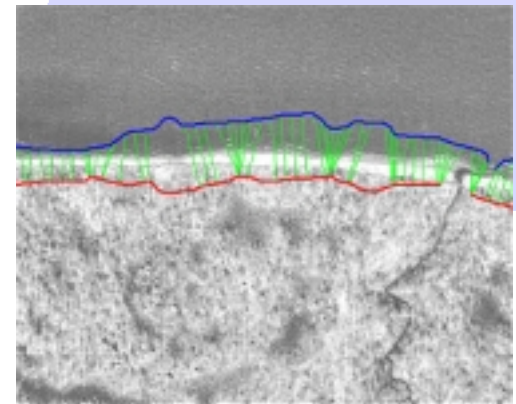
- Subtract terrain models from each other
- Each 10-meter cell (pixel) represents 100 square meters; a 1-meter difference in height = 100 cubic meters
- For 28 mile stretch (1938-1990) :
 - 4 million cubic meters lost
 - 77,000 cubic meters per year
 - 2,800 cubic meters per mile per year

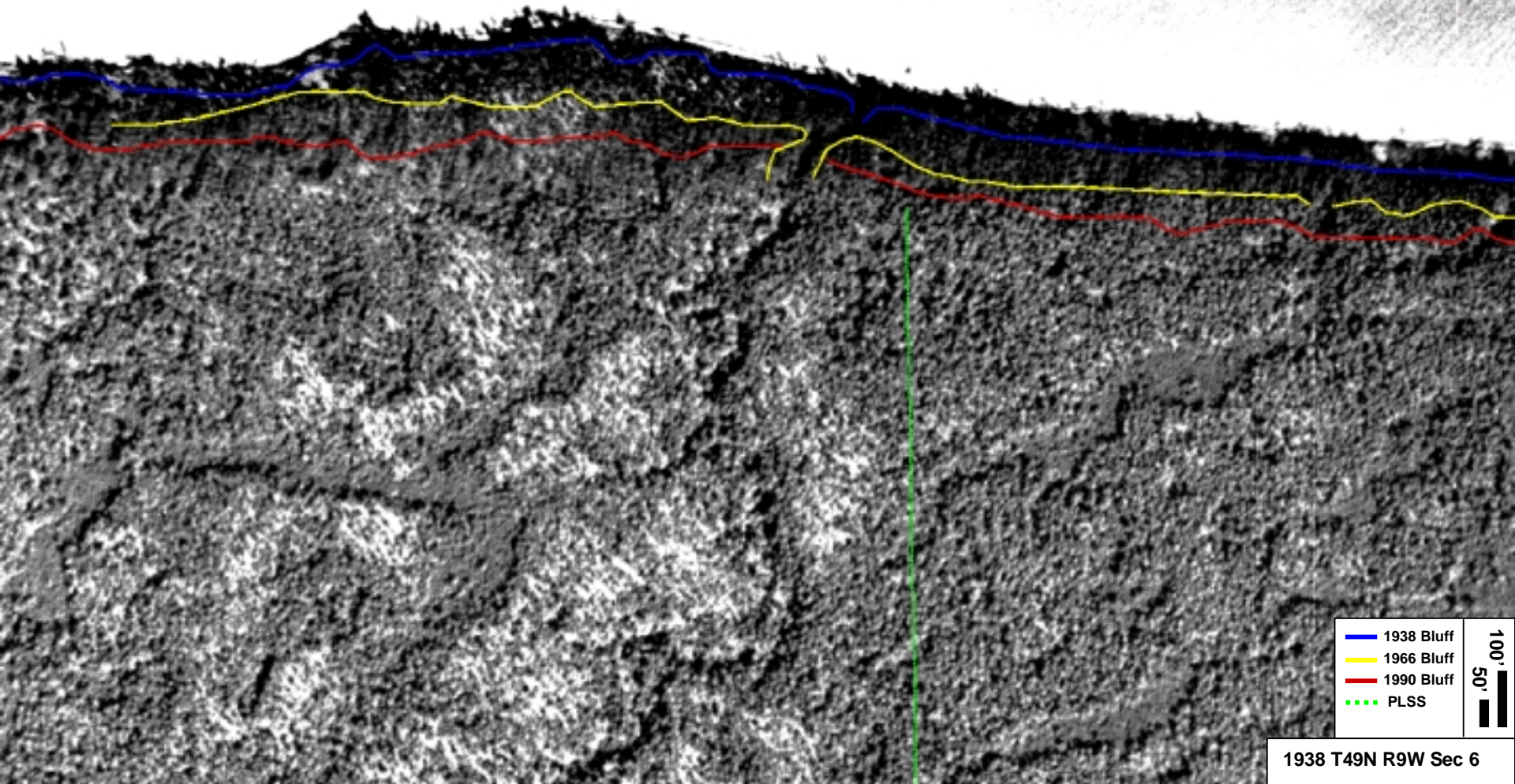




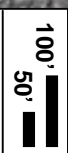
Ridge Recession Analysis

- Software written to calculate distance between bluff lines
- Provides measure of change along entire shore
- Most extreme measure between 1938 and 1990: 57 meters, or 1.1 meters per year

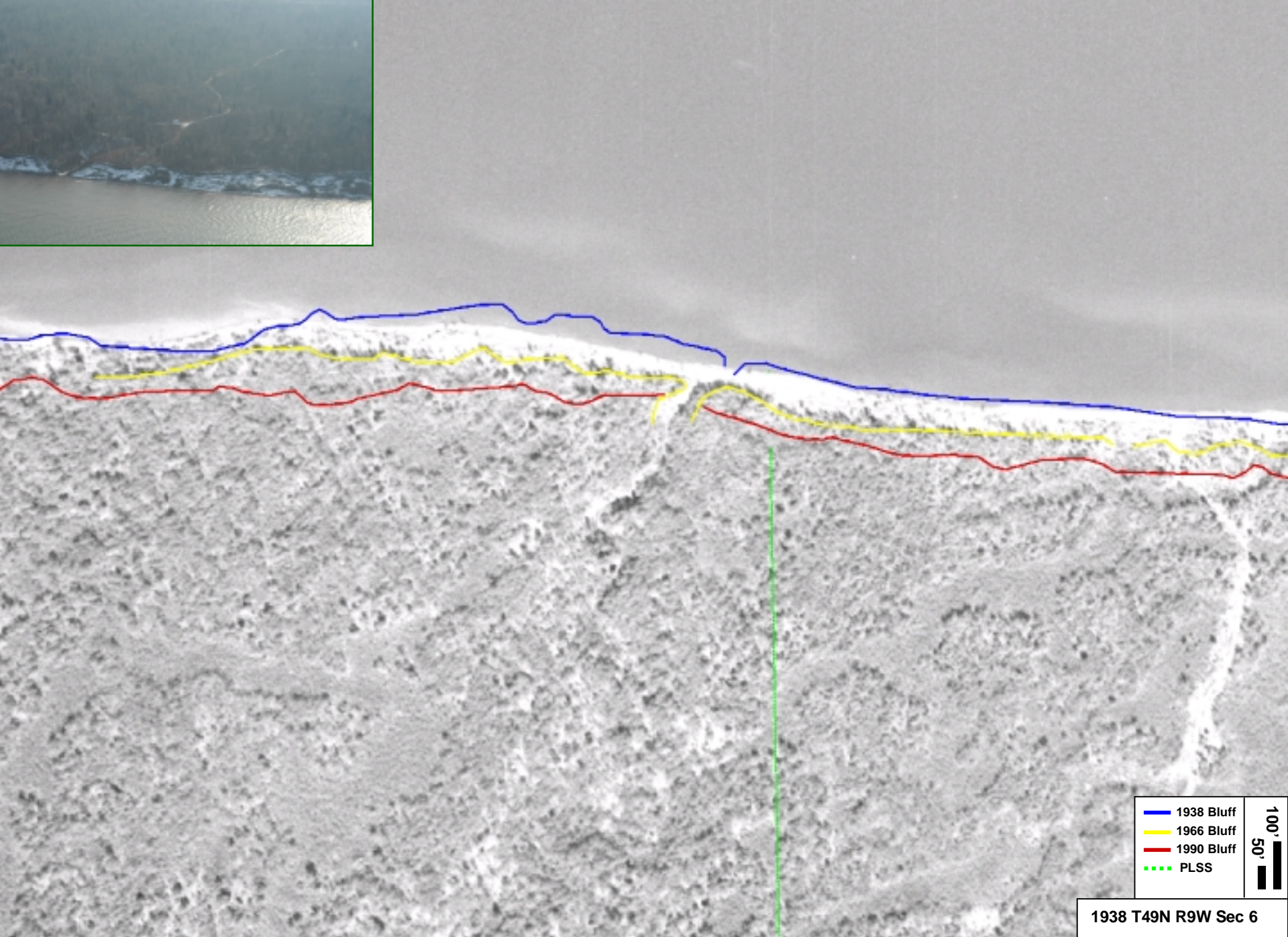




- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



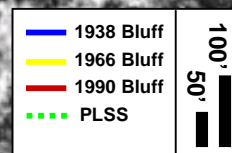
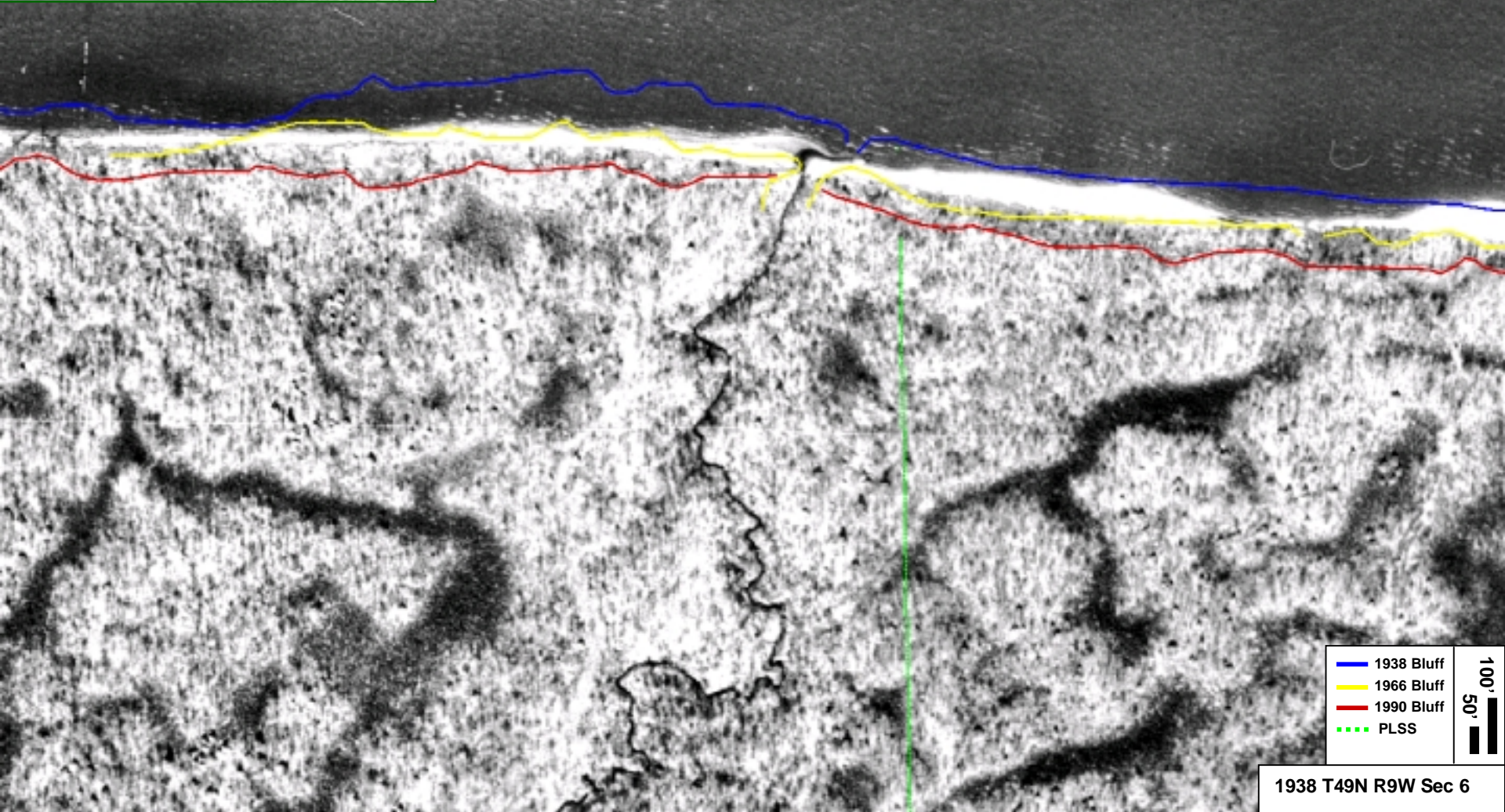
1938 T49N R9W Sec 6



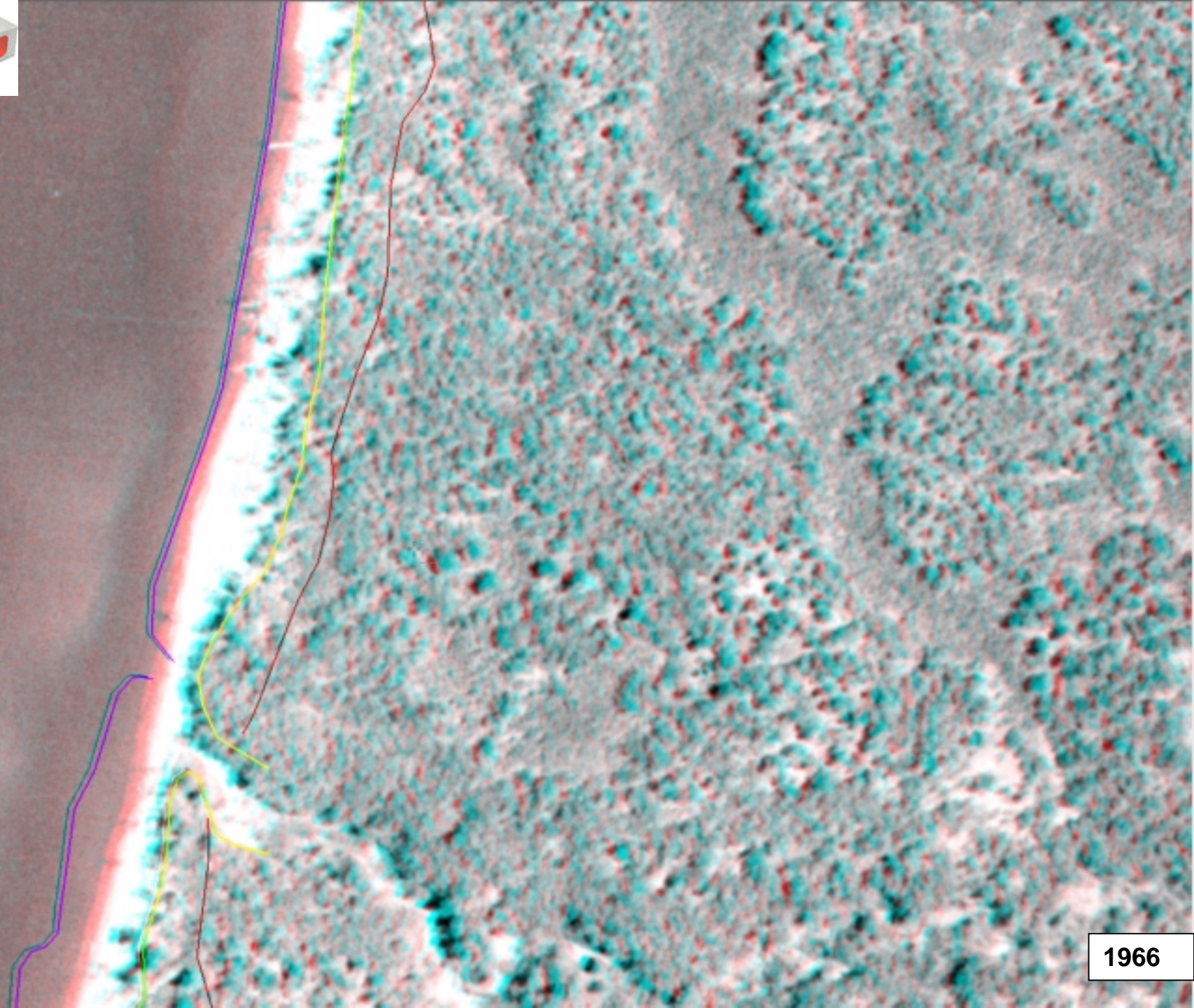
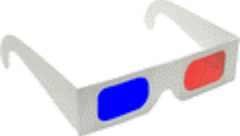
- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



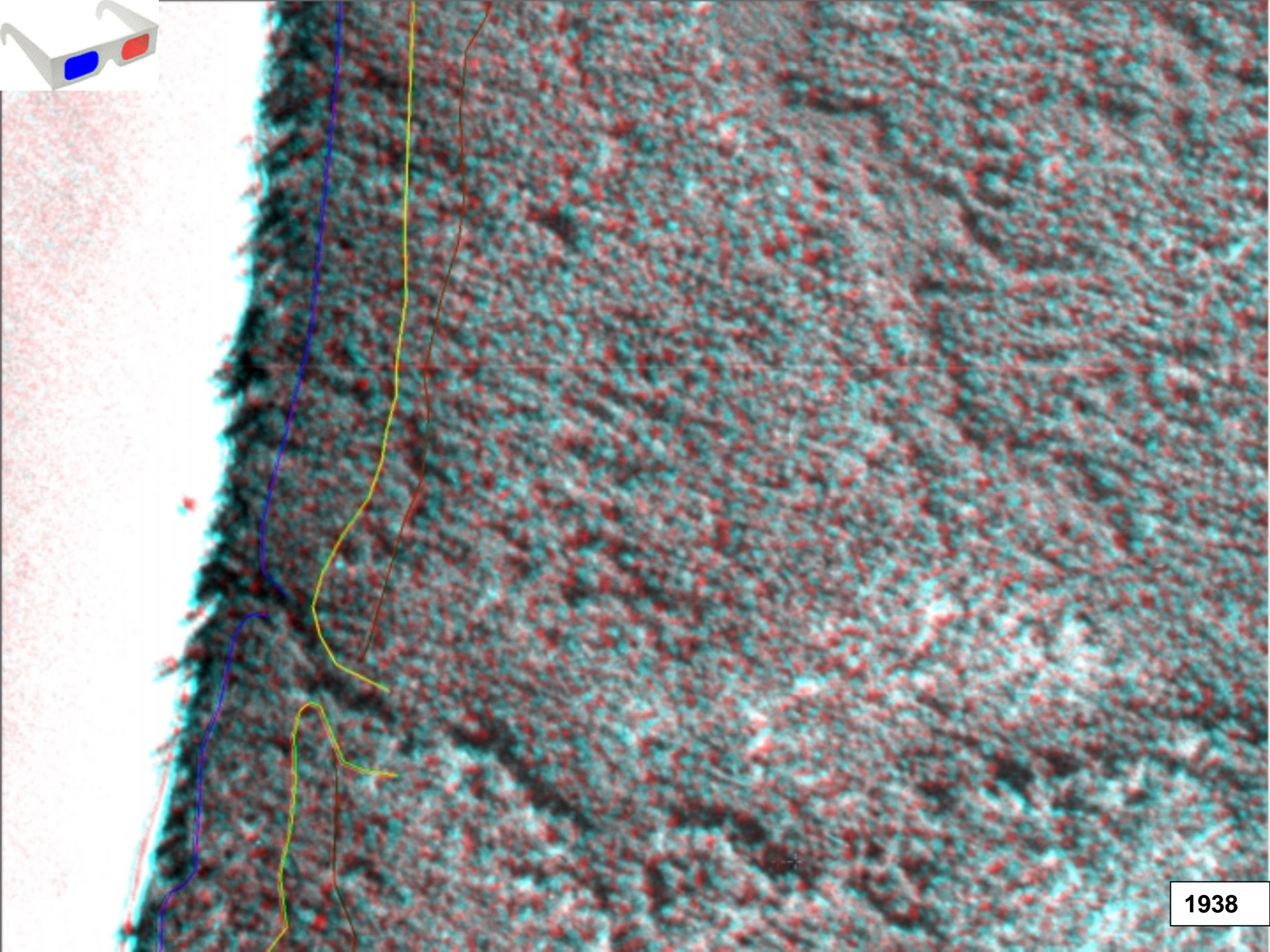
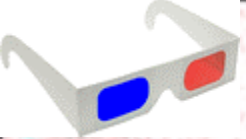
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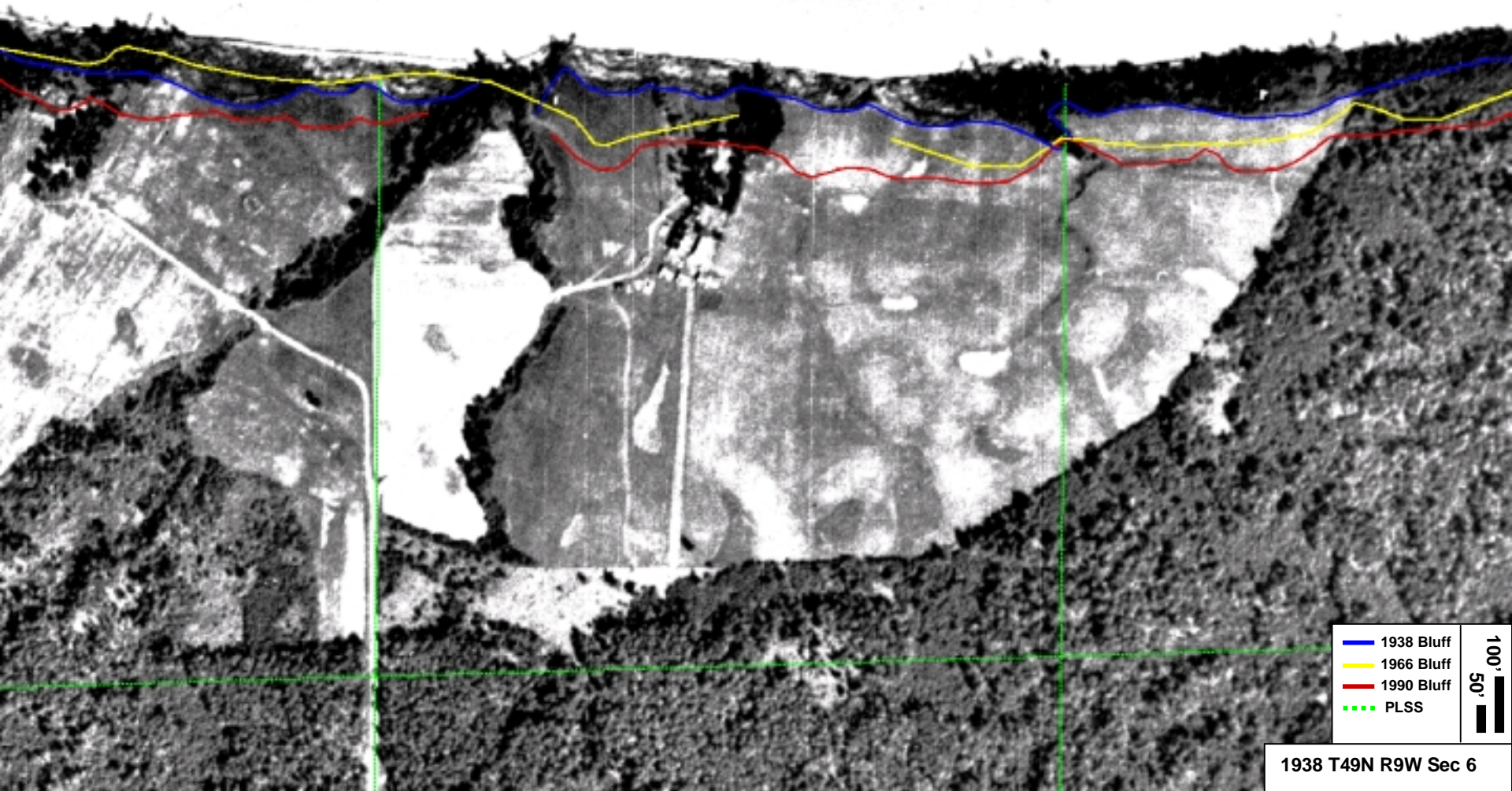


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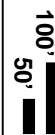


1966

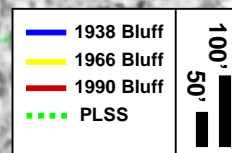
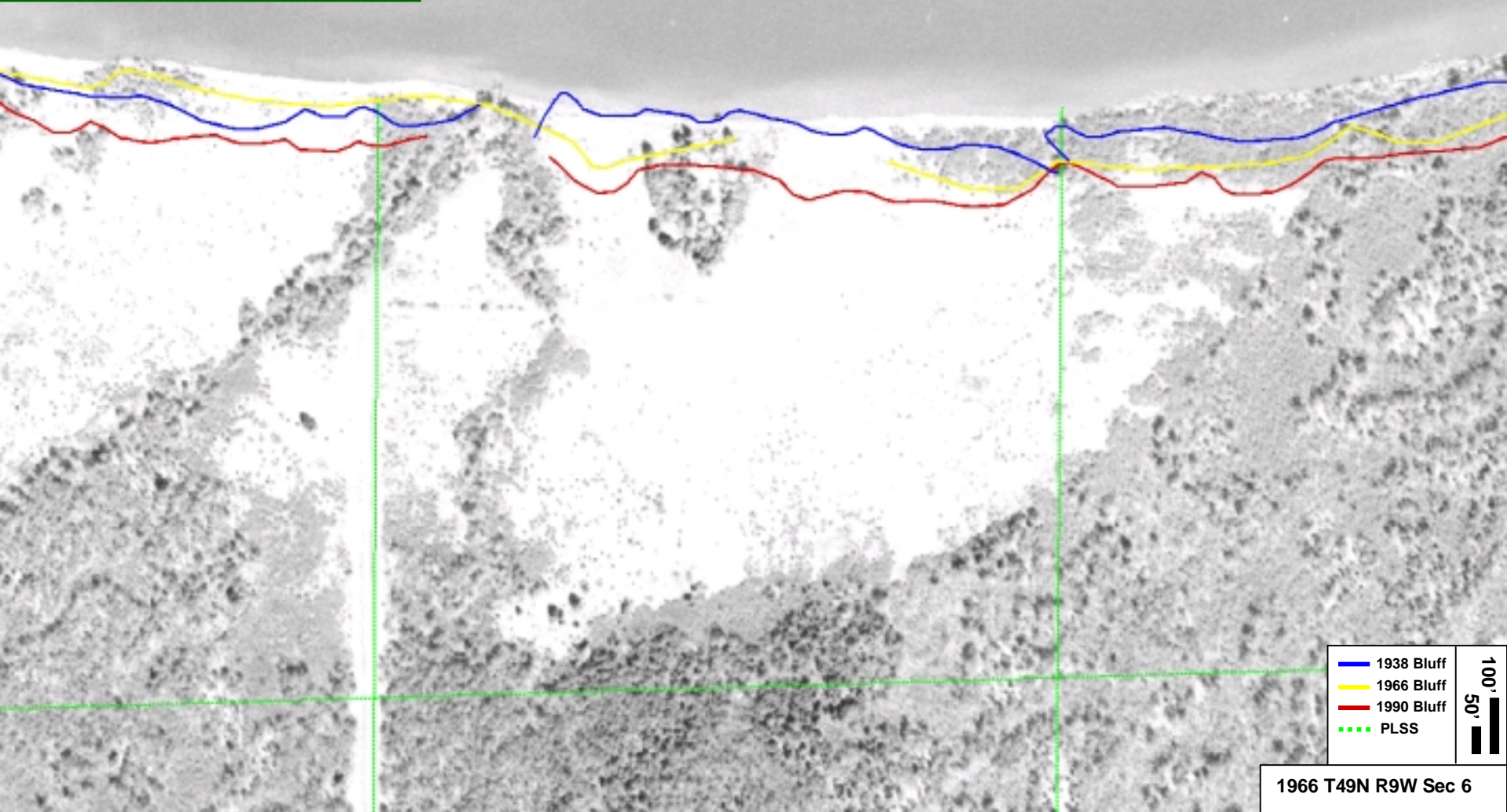




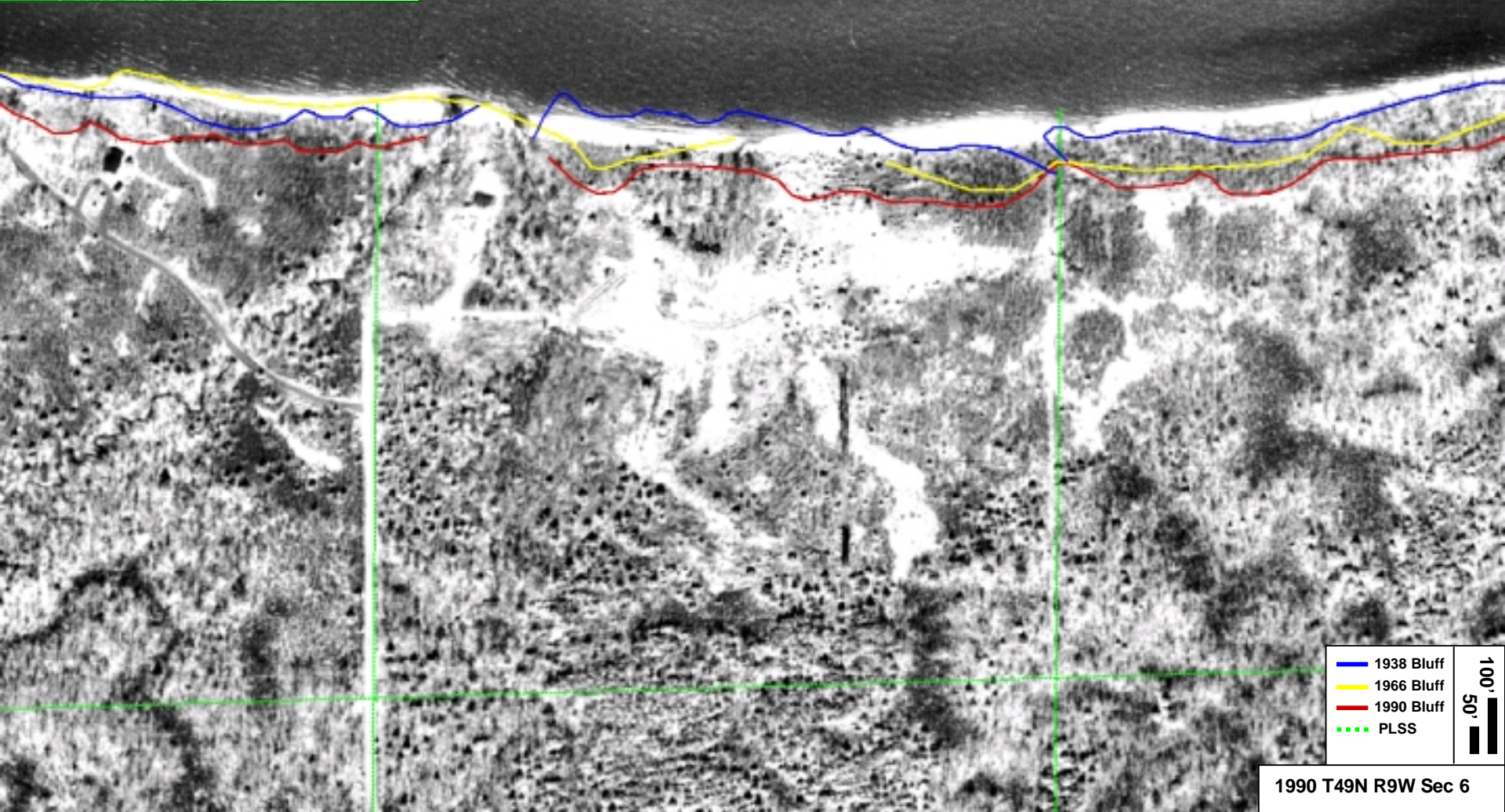
- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



1938 T49N R9W Sec 6



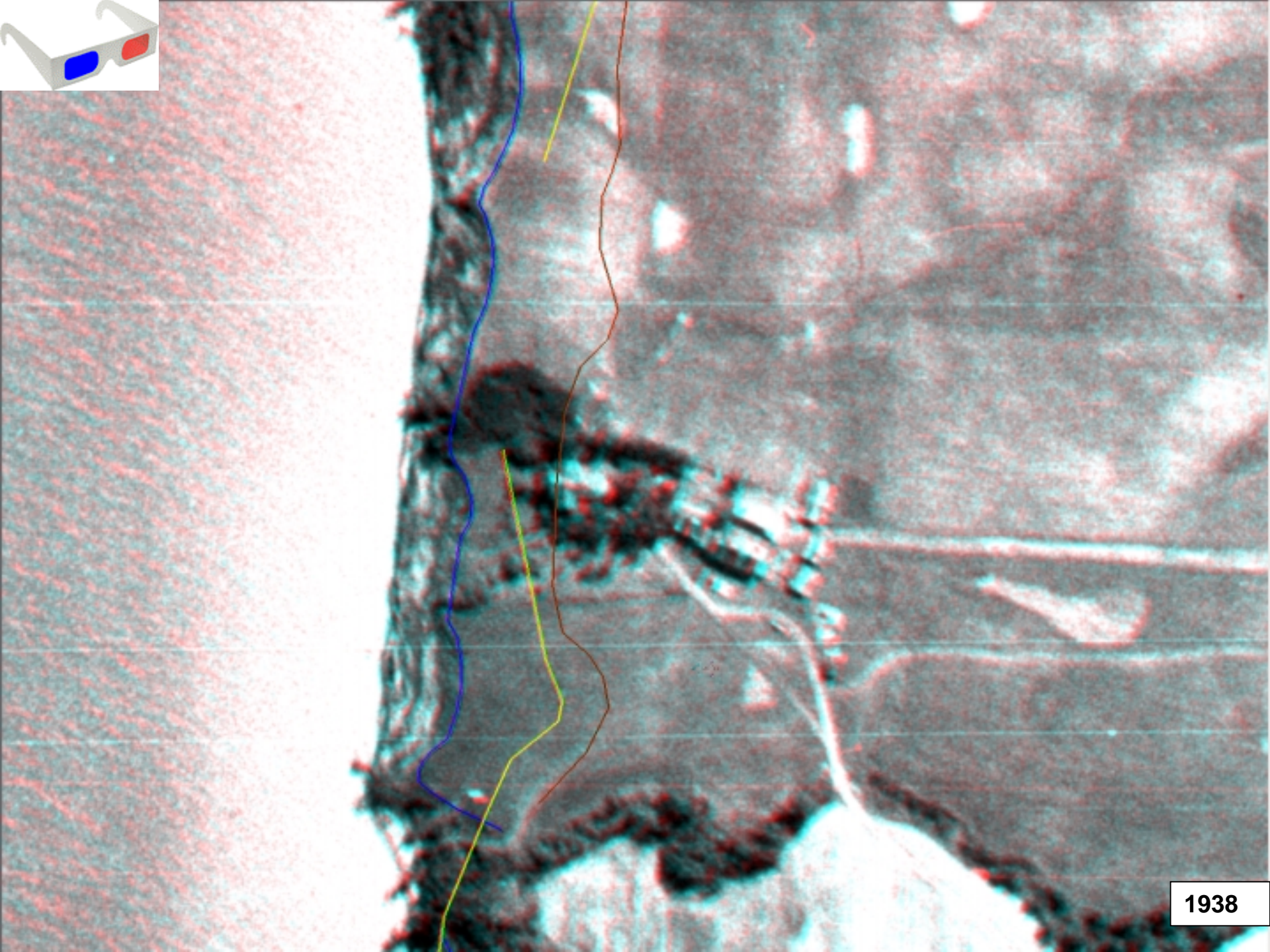
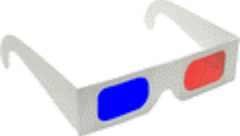
1966 T49N R9W Sec 6



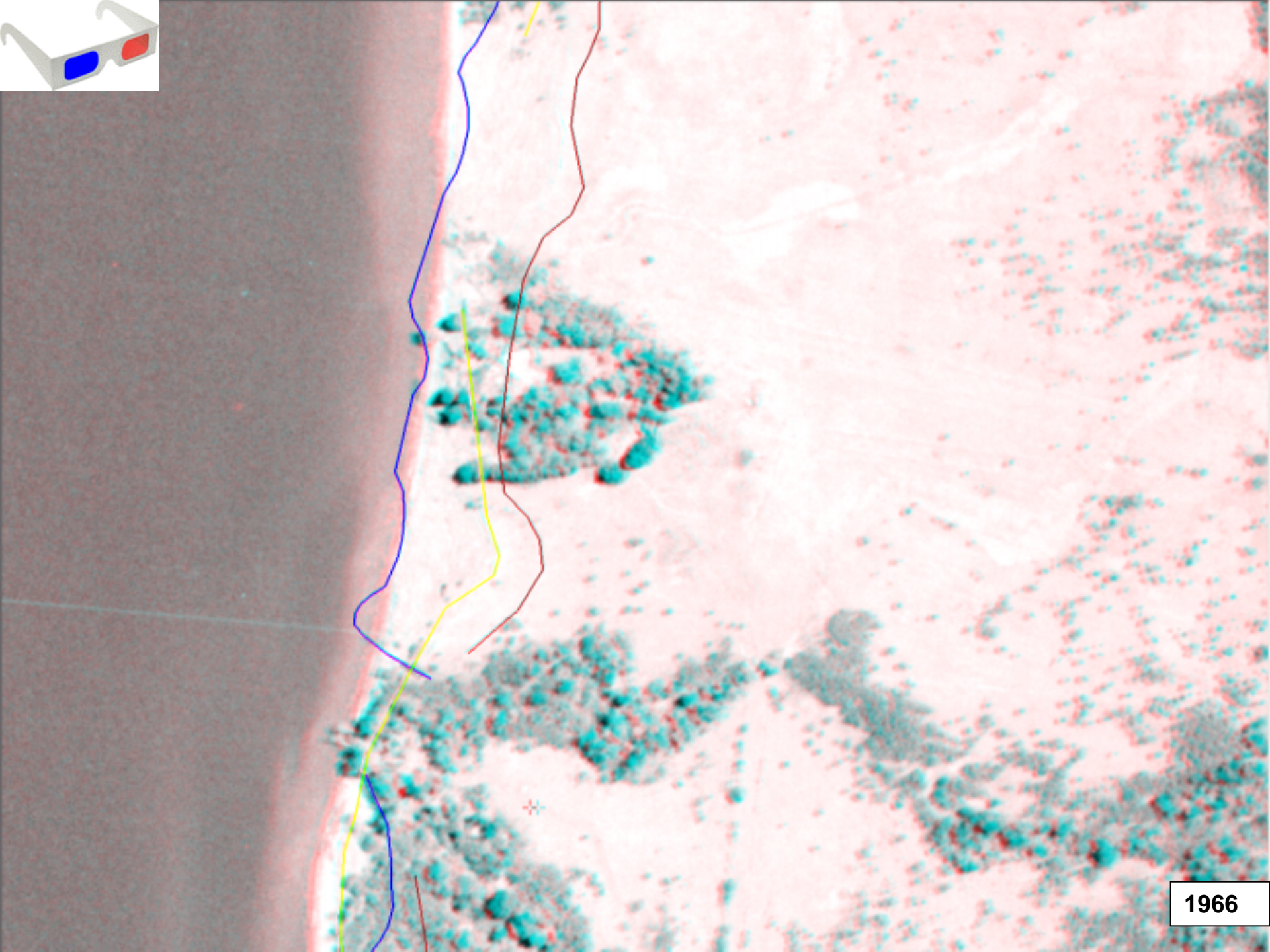
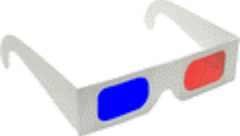
- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS

100'
50'

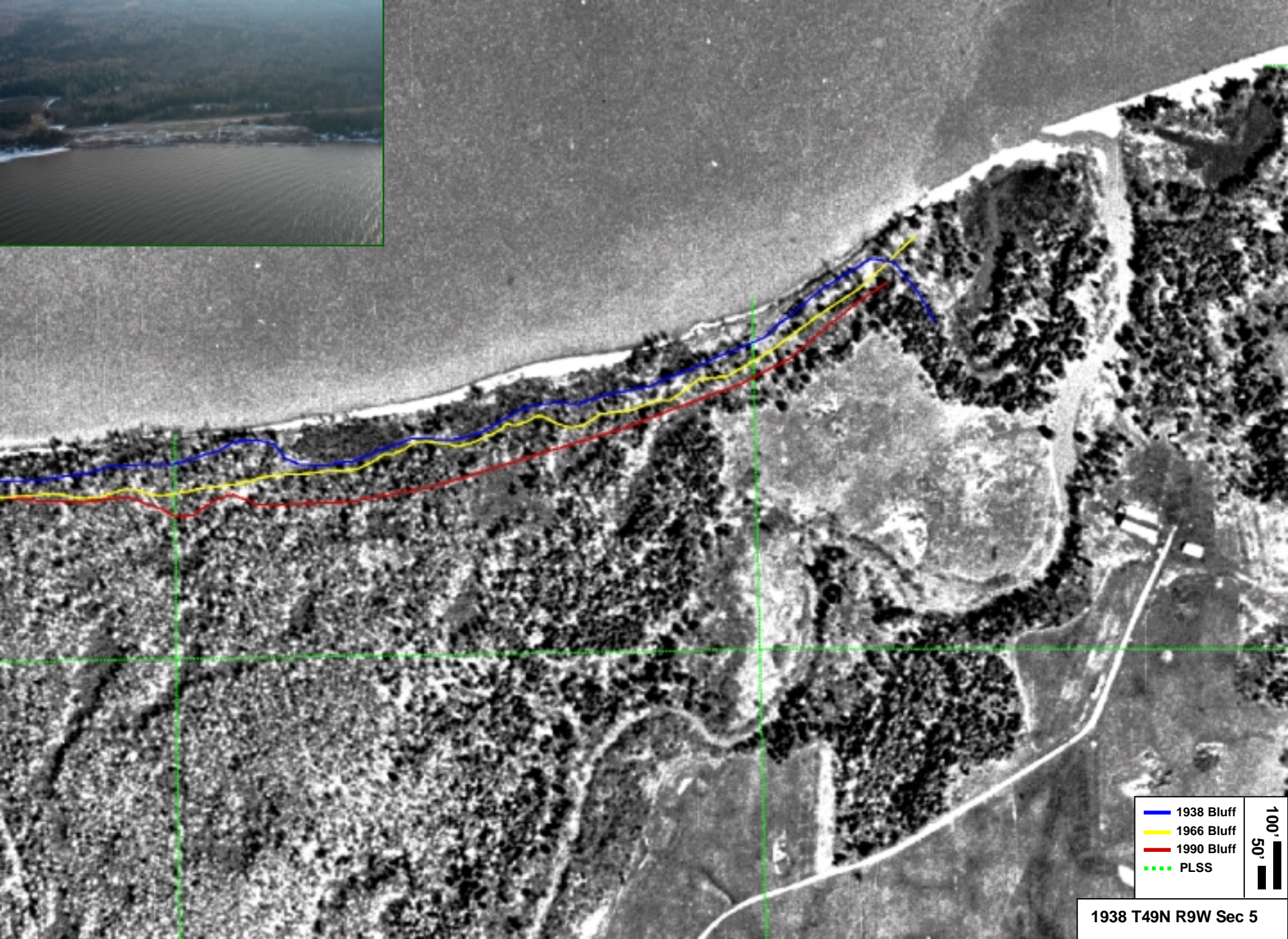
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1938



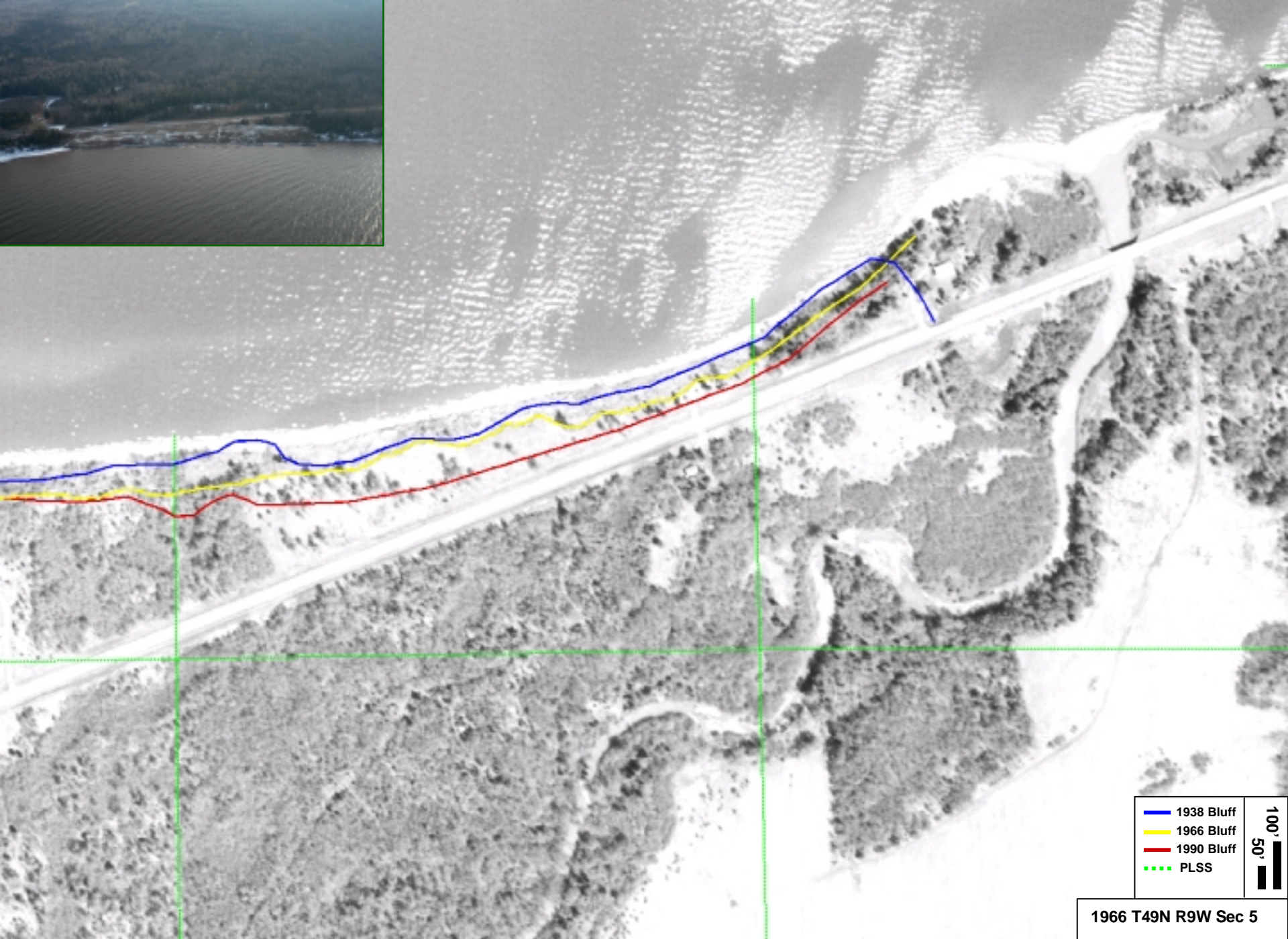
1966



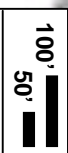
- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



1938 T49N R9W Sec 5



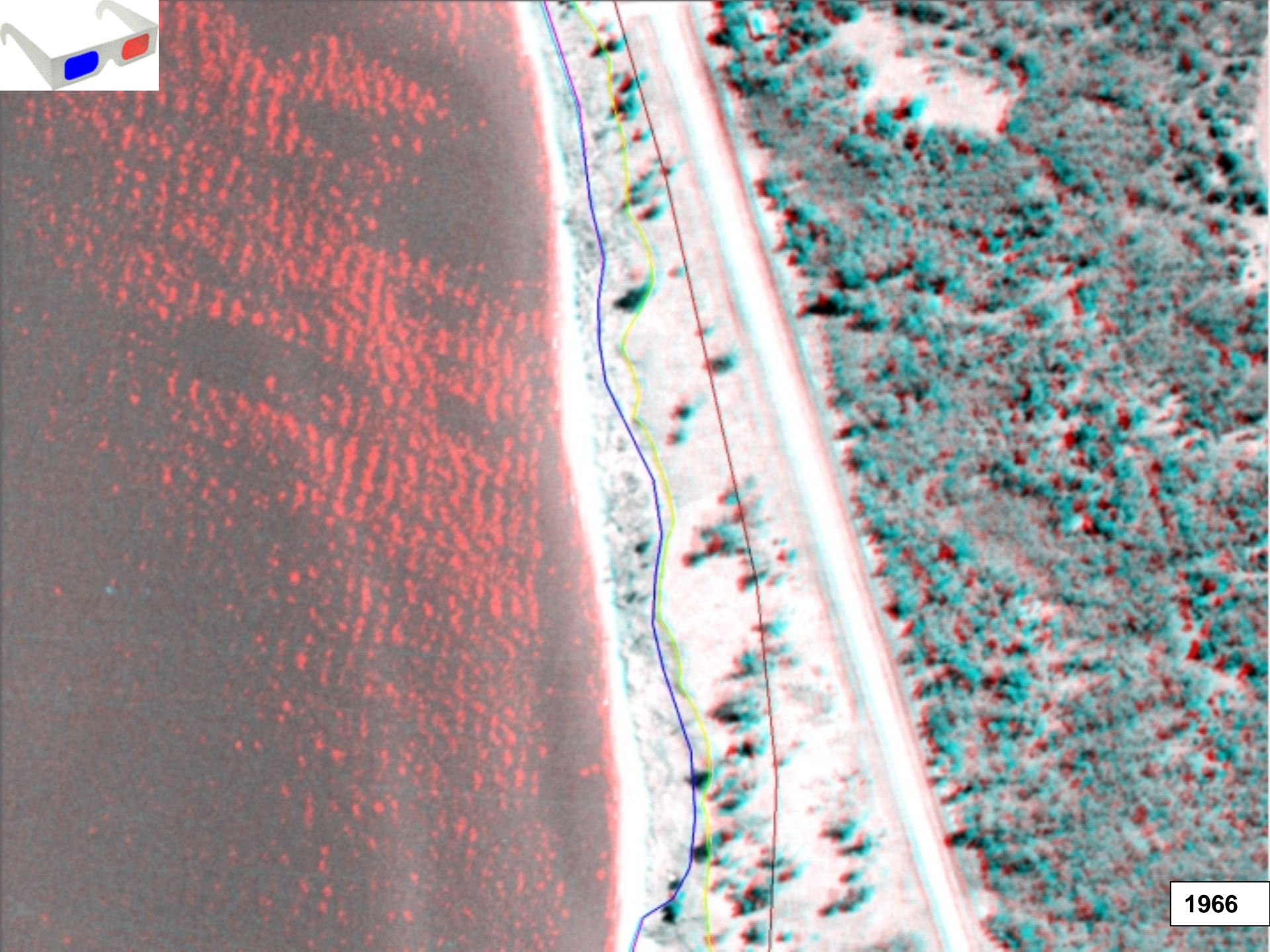
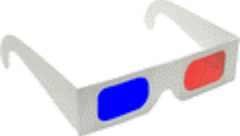
- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



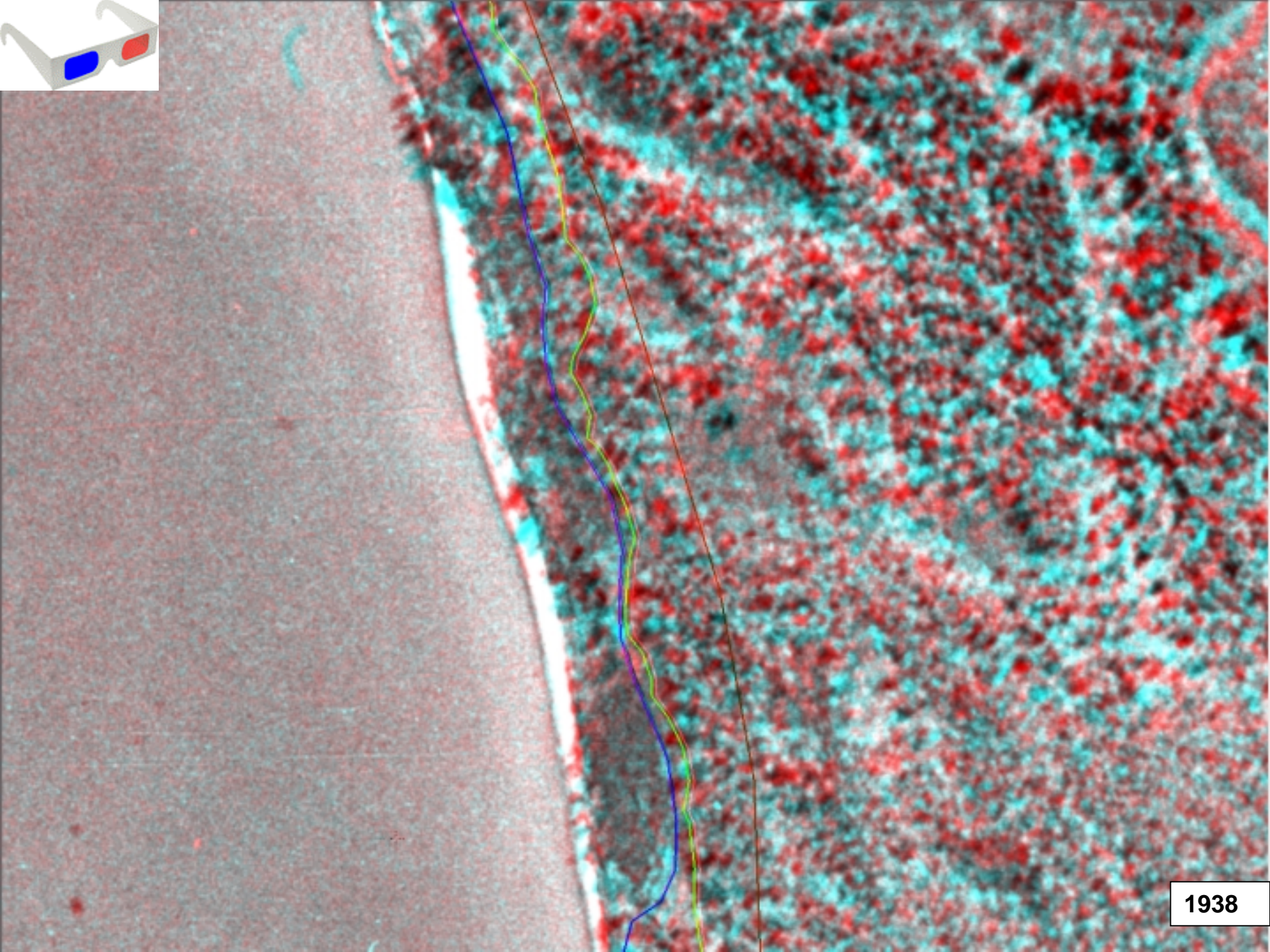
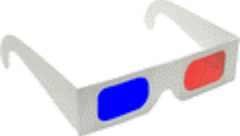
1966 T49N R9W Sec 5



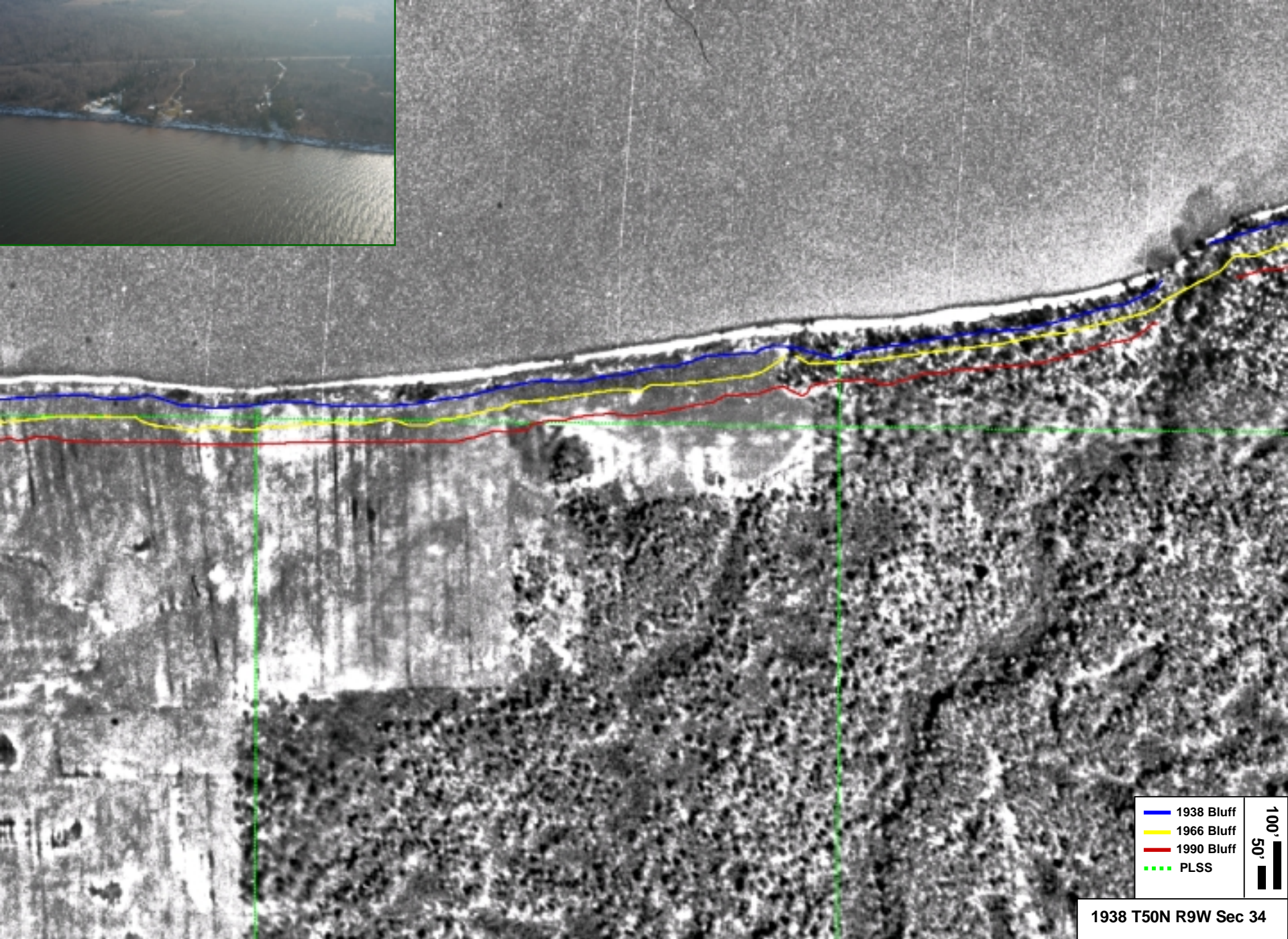
1990 T49N R9W Sec 5



1966



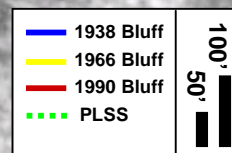
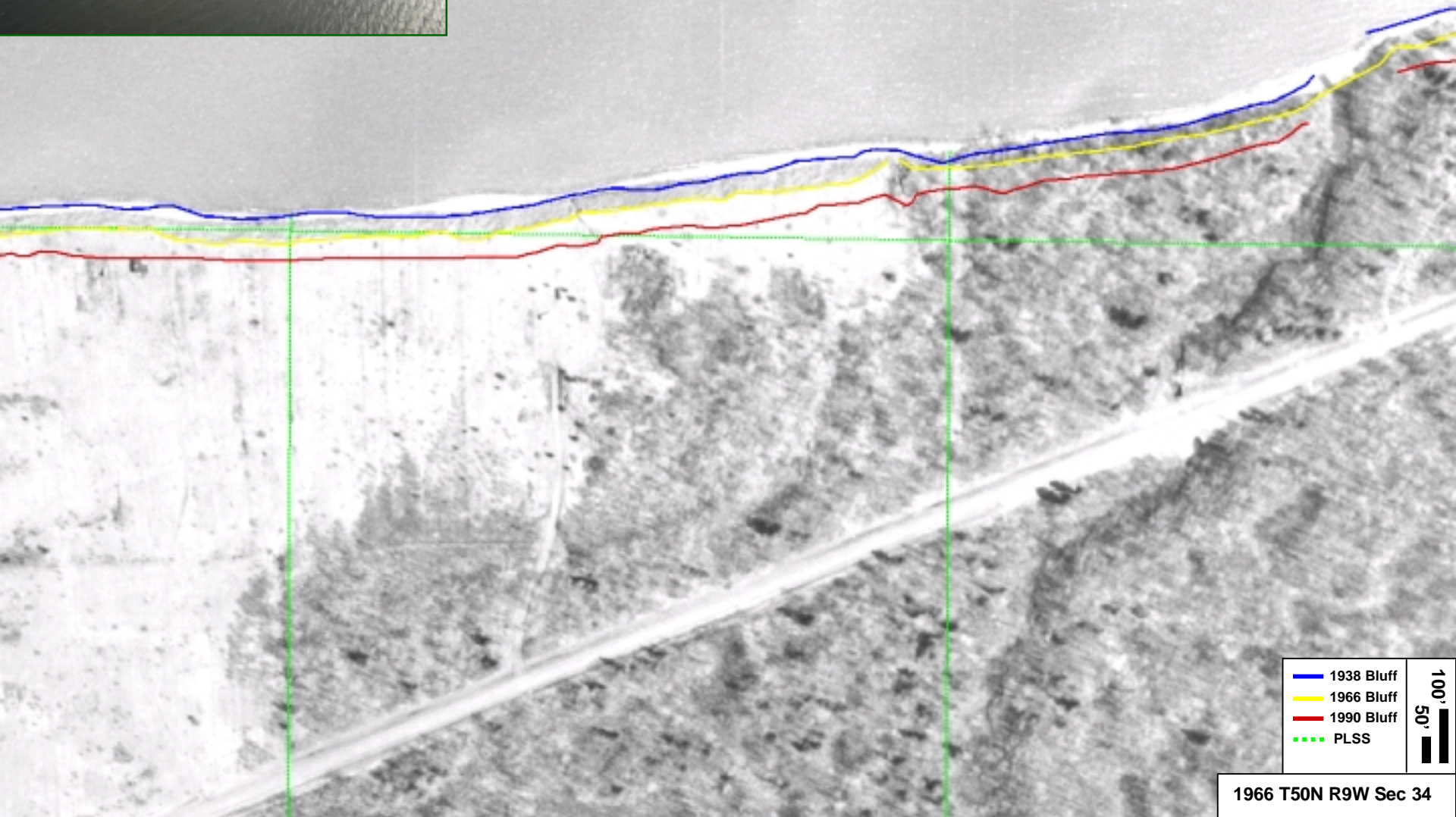
1938



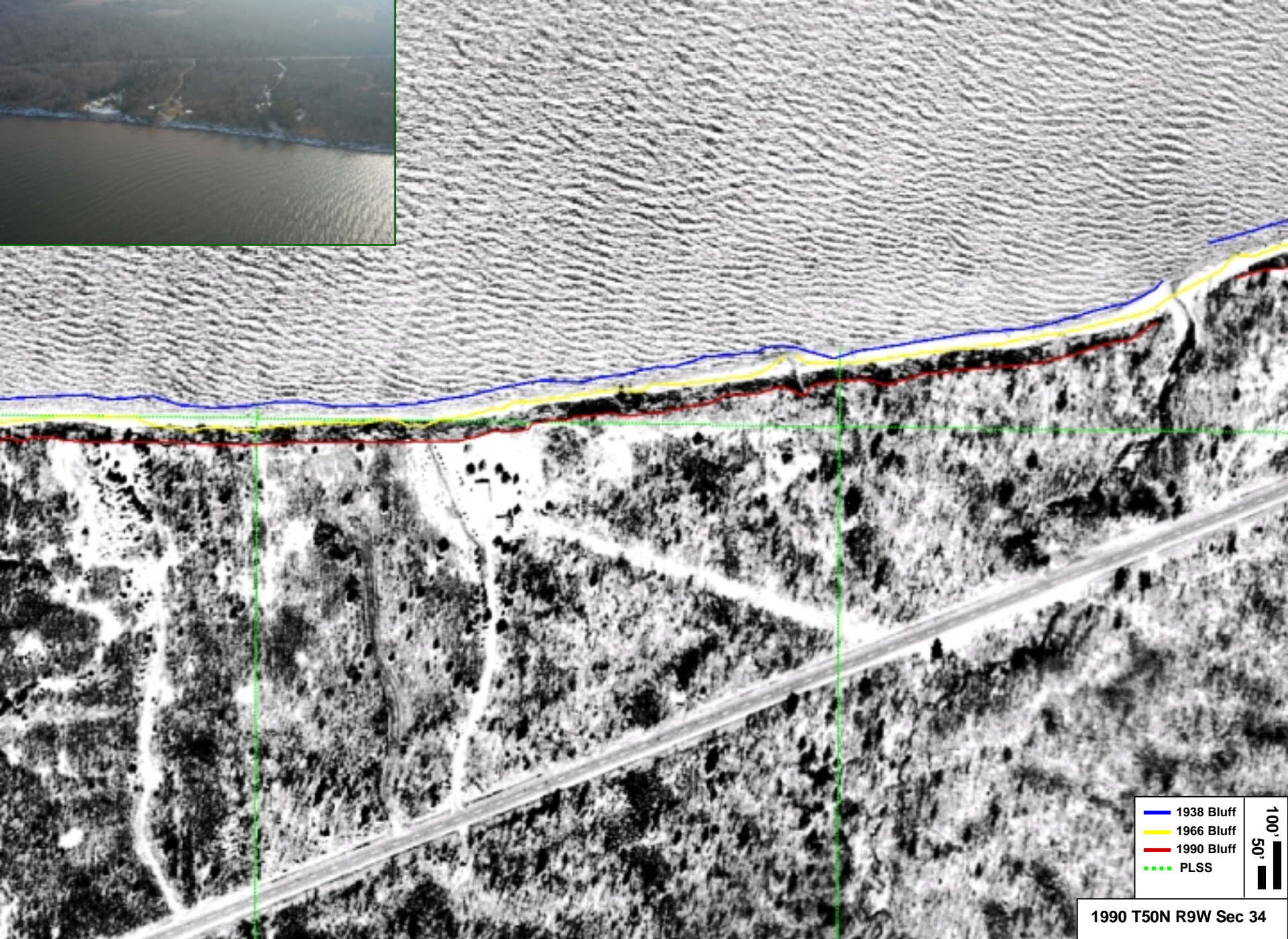
- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



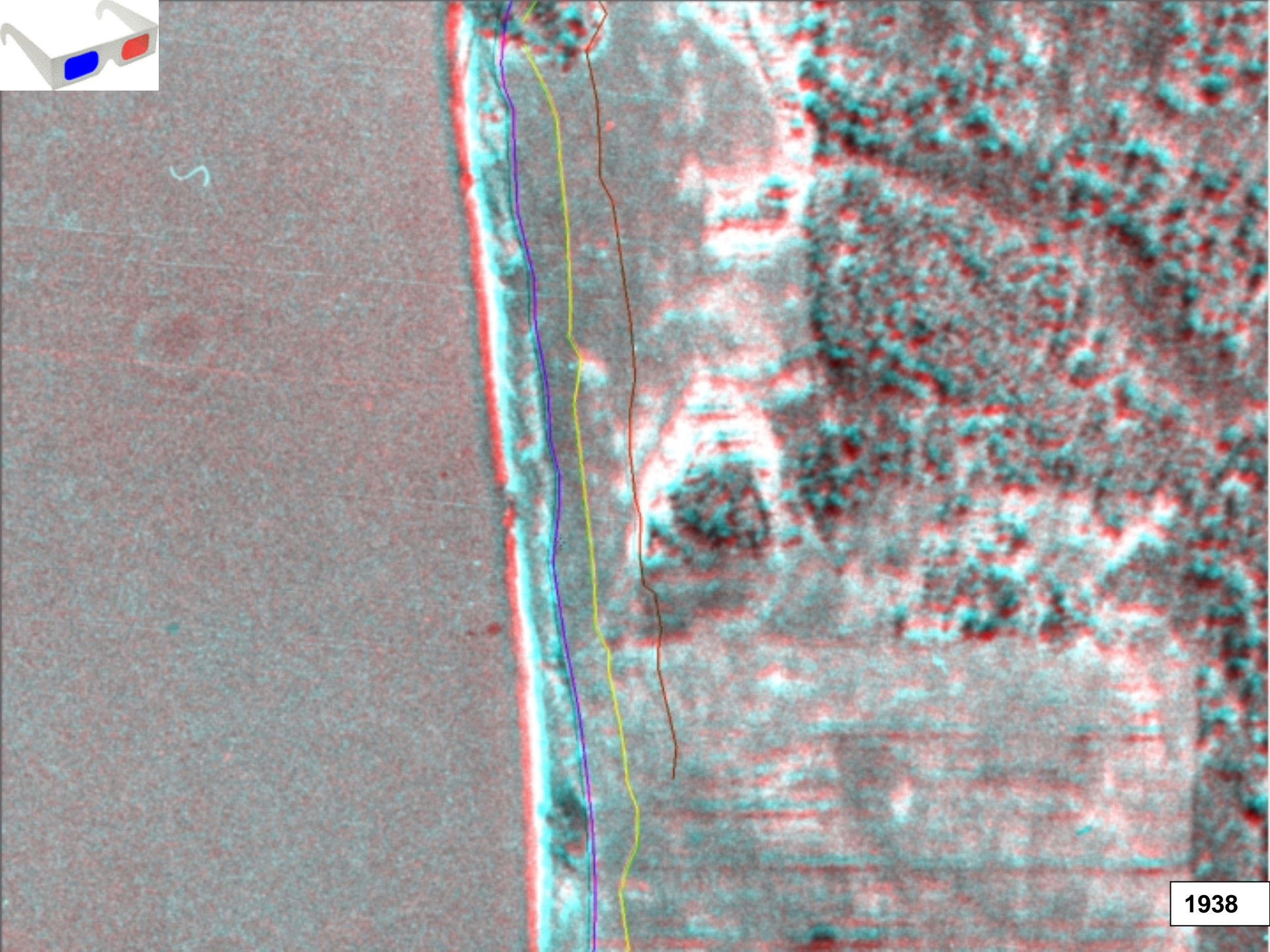
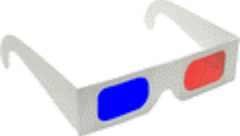
1938 T50N R9W Sec 34



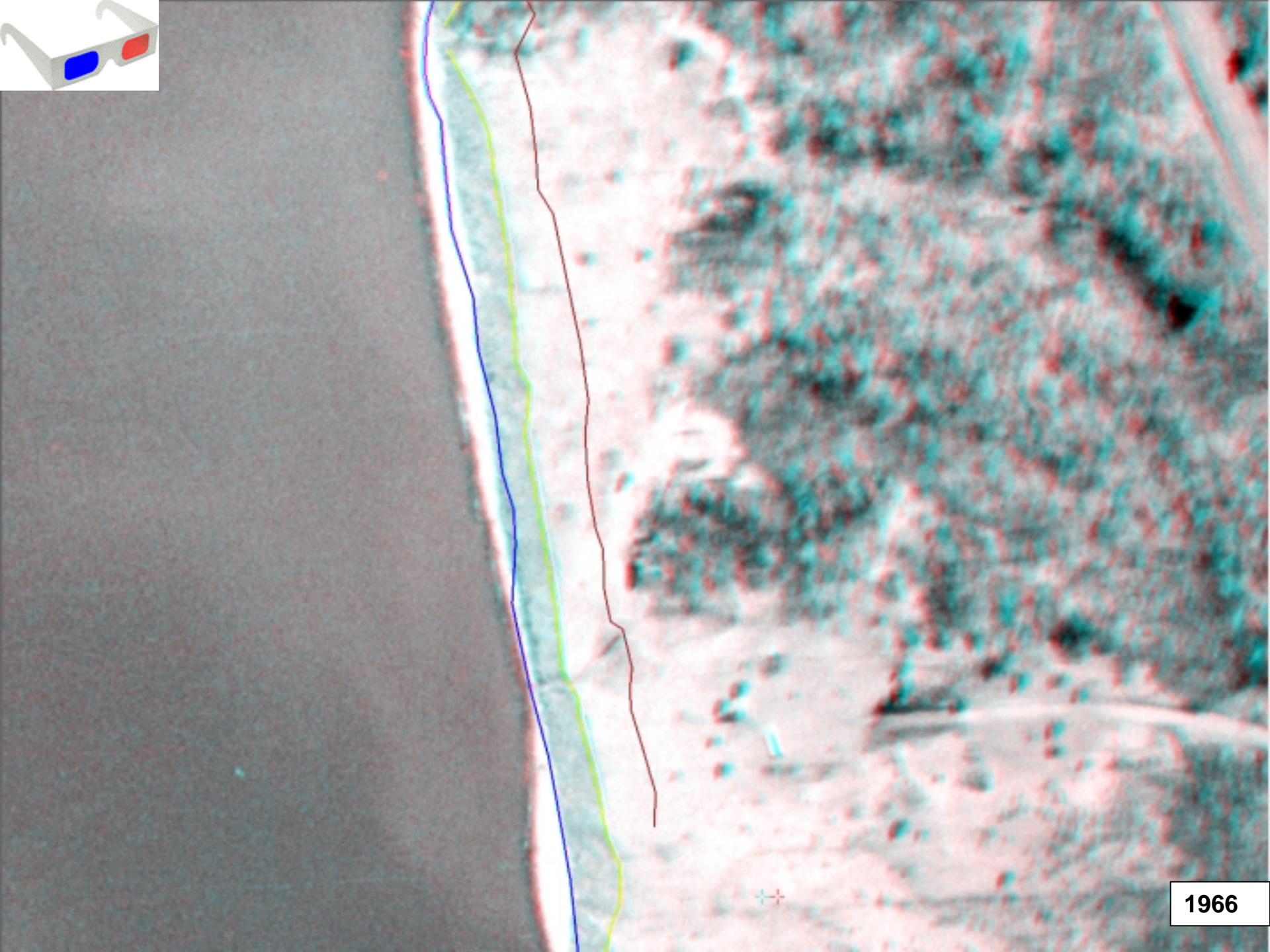
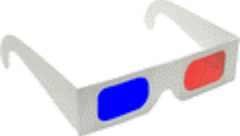
1966 T50N R9W Sec 34



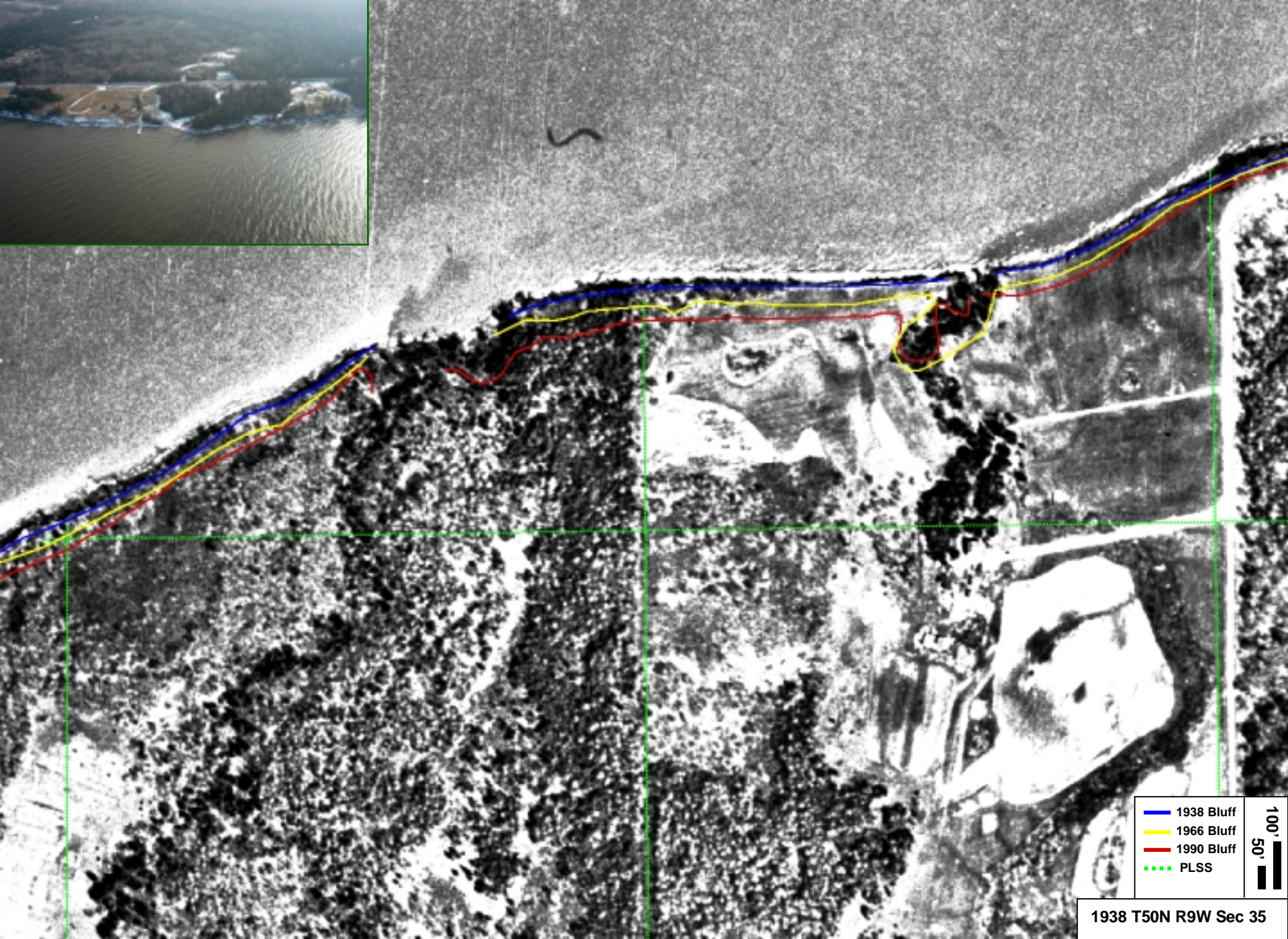
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1938



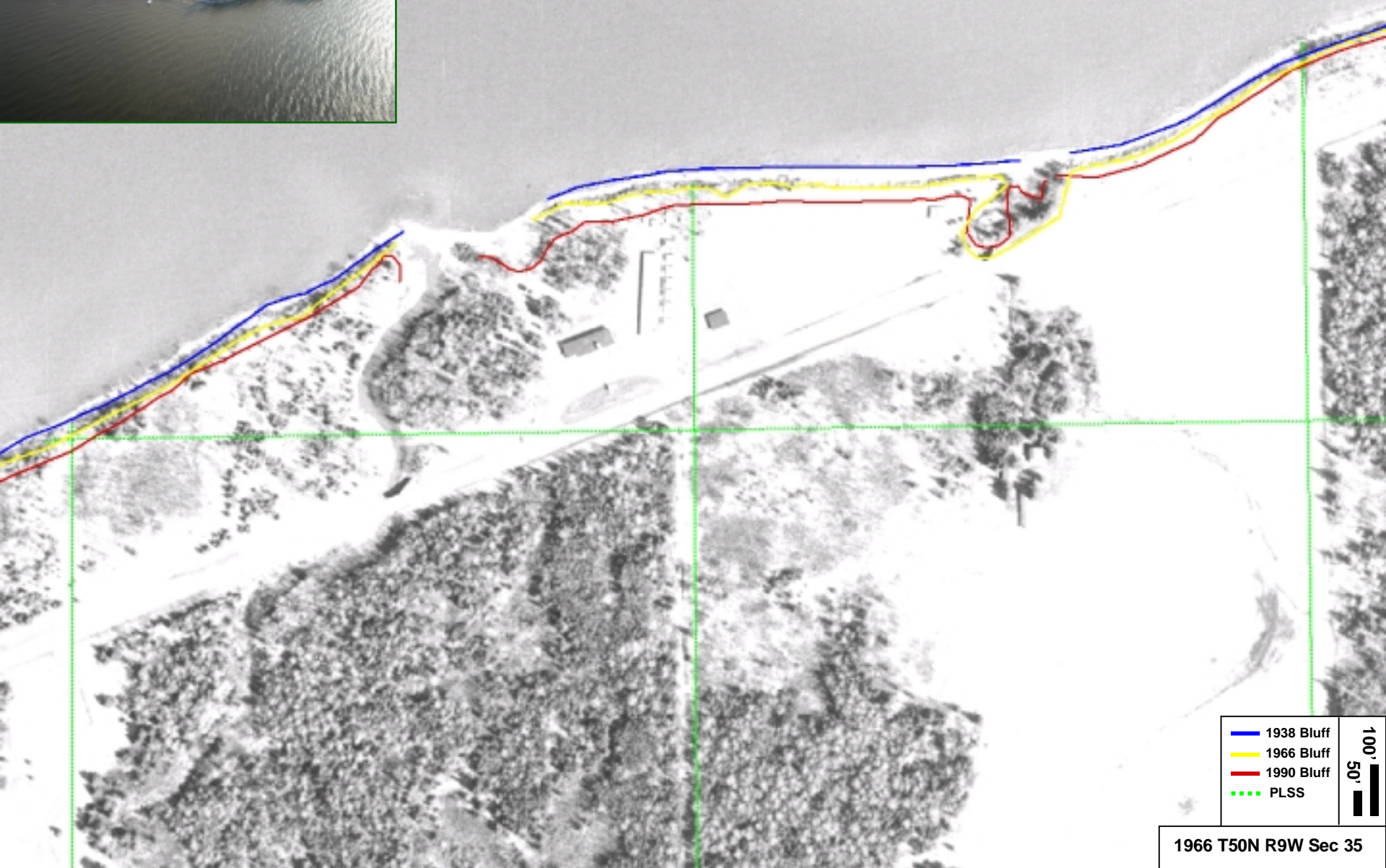
1966



- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS

100'
50'

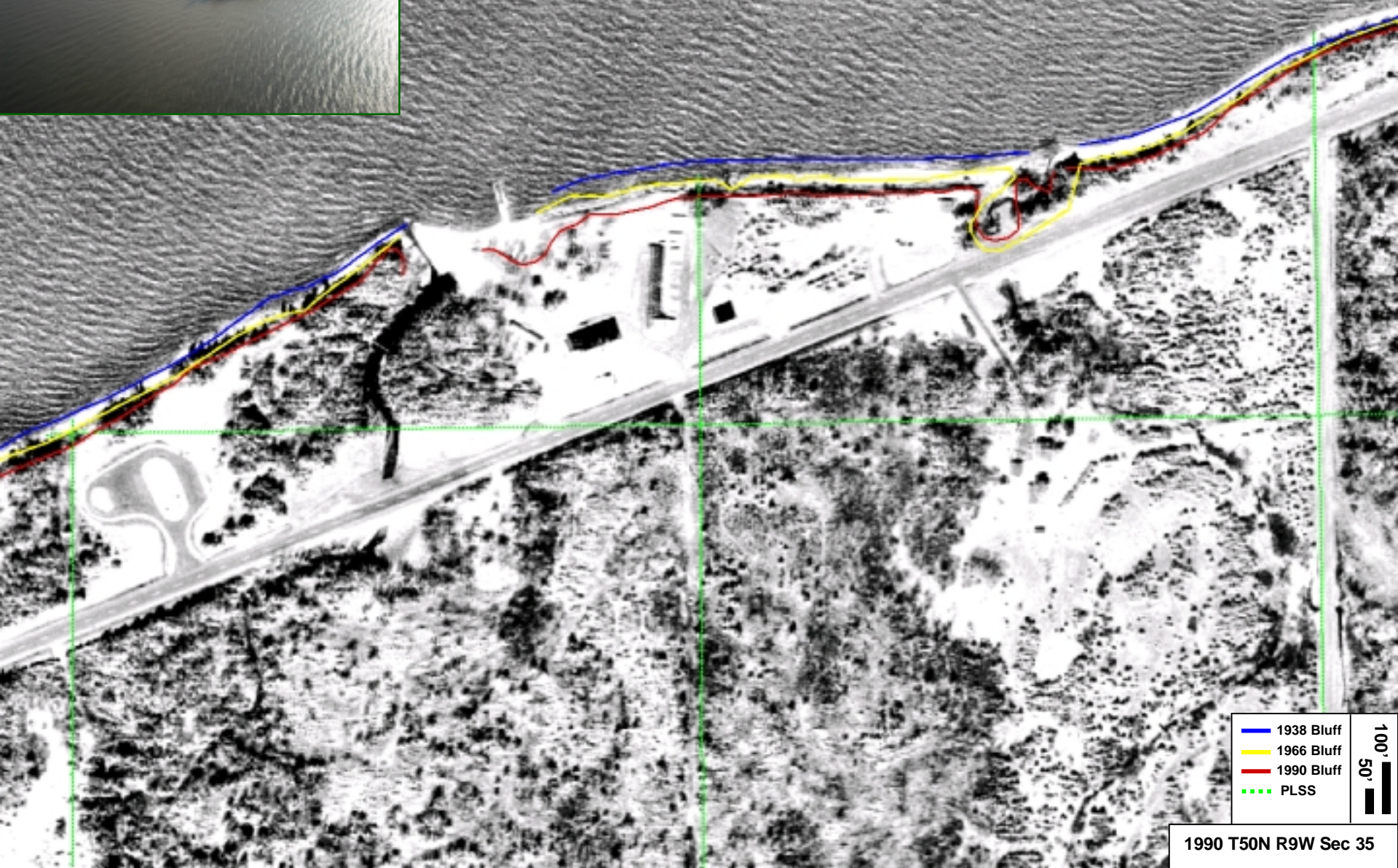
1938 T50N R9W Sec 35



- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS



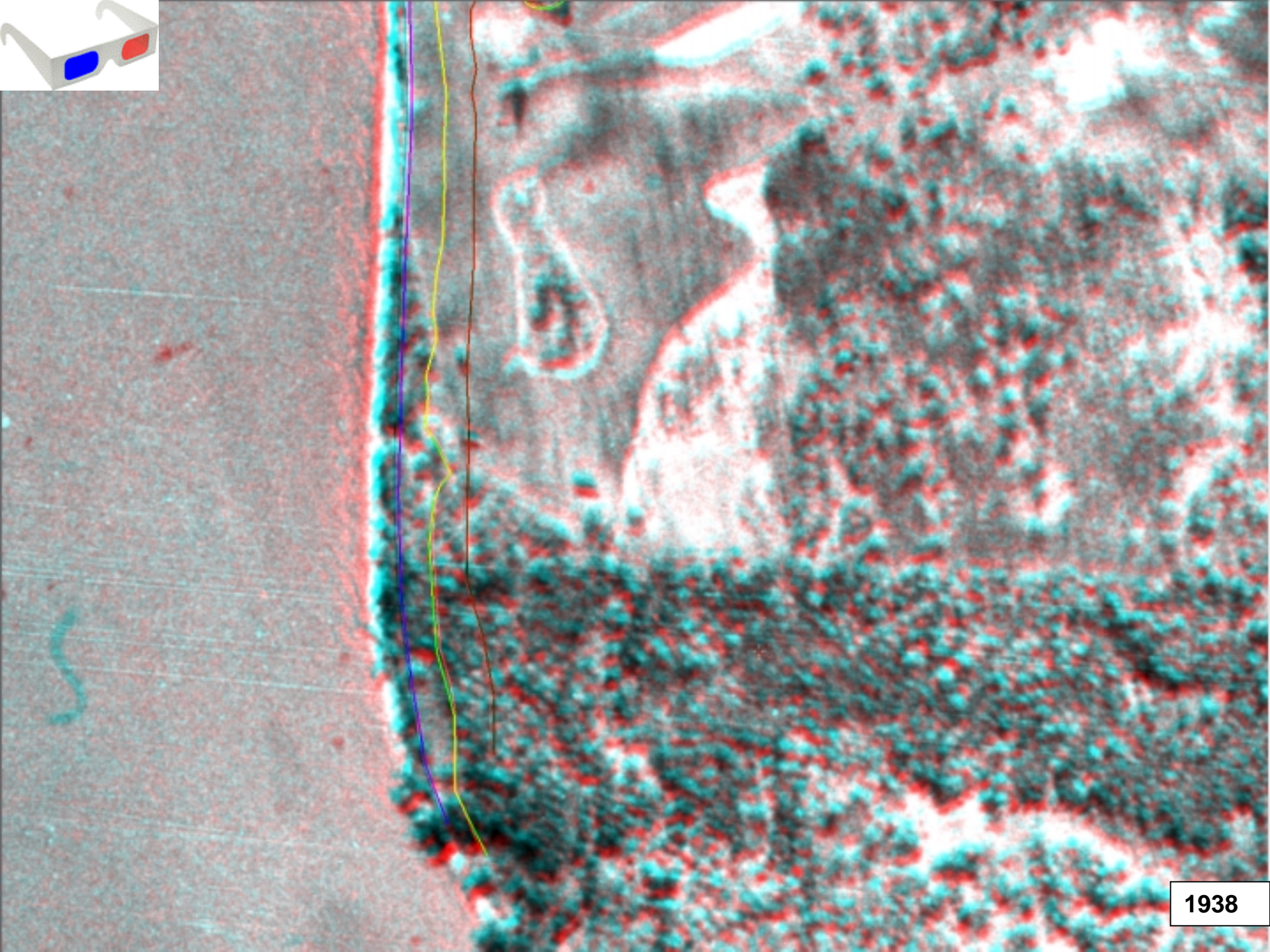
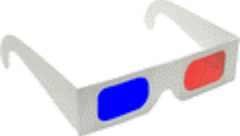
1966 T50N R9W Sec 35

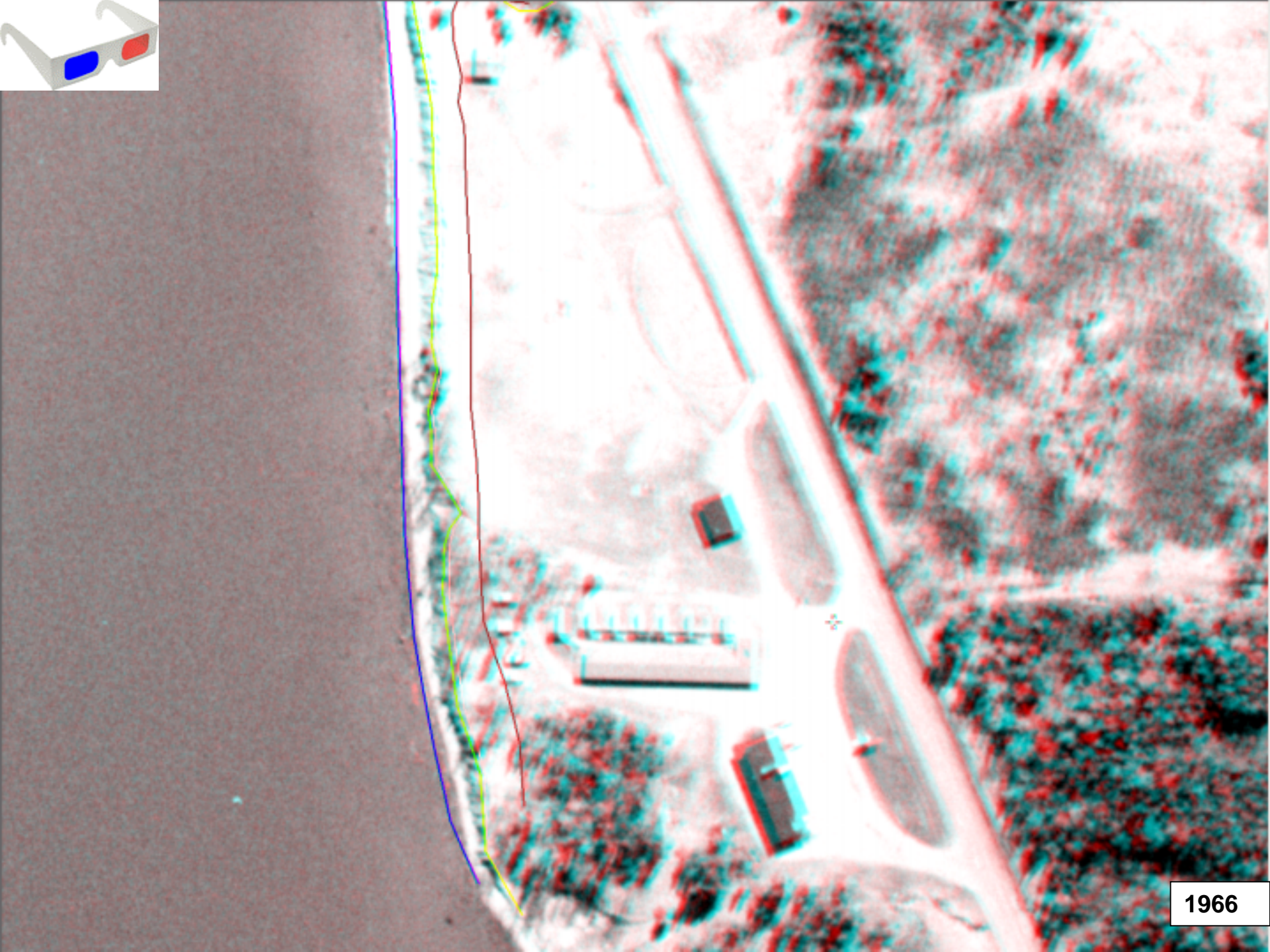
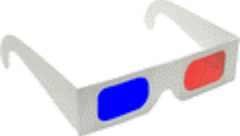


- 1938 Bluff
- 1966 Bluff
- 1990 Bluff
- PLSS

100'
50'

1990 T50N R9W Sec 35

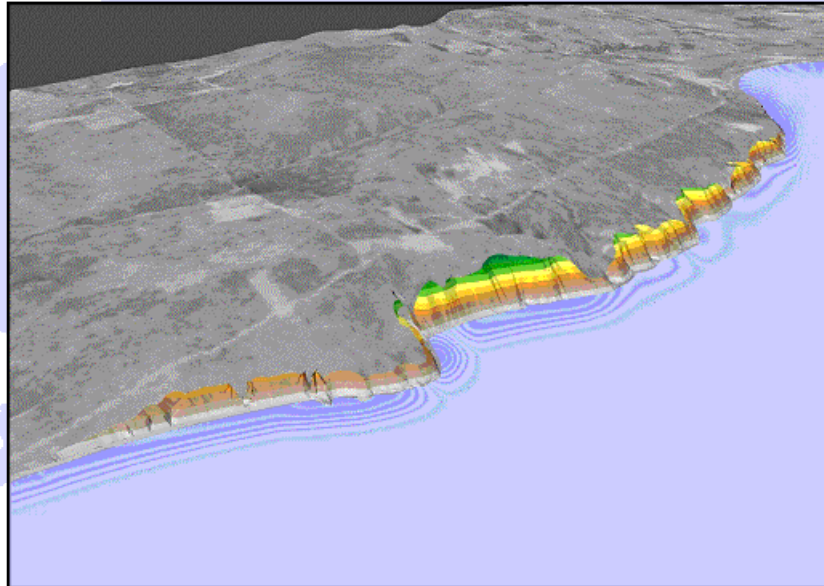




1966

Project Results

- Low cost softcopy photogrammetric workstation can provide reasonably accurate data, especially for non-engineering applications



Oblique Shoreline Imagery





Objectives

- Create a set of photographs providing a baseline for observing changes over time.
- To provide objective scientific information to the local community.
- Create archive to provide a ready source of imagery that can be useful for land use planning efforts, public meetings, educational displays, etc.






Project Accomplishments

- 513 photos (Fish Creek to Brule River), November 2002
- High Resolution images - 2240 x 1488
- GPS used to record camera position
- Employed the expertise of Bad River Natural Resources personnel
- Created "ShoreViewer" on Land Records website:
http://www.bayfieldcounty.org/LandRecords/shoreviewer_start.htm
- Created "Lake Superior Shore Profile Analysis" on Land Records website:
http://www.bayfieldcounty.org/LandRecords/shore_2002/info_uwprofiles.htm



Land Records Home Page



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[Aerial Photography](#)
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[Geodetic Control](#)
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Bayfield County Land Records Department

Quick jump to...

Land Records Home


August 2003

Welcome to the Bayfield County Land Records Department's web page! The goal of the Land Records Department is to compile and create land records, (information with a geographical component), and to make this data accessible to those needing this information.

Unlike the 17th century cartographers indicted in Swift's poem, it is our intent not to fill these pages with superfluous compass roses or 'elephants', but, rather, to provide meaningful spatial information about Bayfield County. We sincerely hope you find this web site informative and helpful.

*So Geographers, in Afternoons,
 With savage pictures fill their pages;
 And 'tis for unprofitable pains
 Their elephants for want of noses.
 Jonathan Swift, 1733*

Dave
 Dave Lee
 Administrator, Land Records Department




Bayfield County Land Records Department
 Bayfield County Courthouse
 P.O. Box 878
 117 East Fifth Street
 Washburn, WI 54891


715-373-6156 phone
 715-373-6153 fax

Open Monday through Friday
 8:00 am to 4:00 pm


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NEW! View maps online with MapViewer.



NEW! Explore Lake Superior's shoreline.

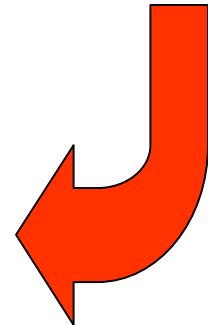


Download Bayfield County tax parcel maps




Find out about available digital aerial photography

ShoreViewer



ShoreViewer



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Bayfield County Land Records Department

Quick jump to...

Lake Superior Shoreline

September 2003

Bayfield County is blessed with some of the most scenic shoreline along the Lake Superior coast. From low coastal wetlands to towering sandstone bluffs, the shoreline along Bayfield County exhibits a dynamic range of form and beauty. Our shoreline is a valued natural heritage and a treasured resource for landowners and visitors alike.

What comes as a surprise to many is that the shoreline along Lake Superior is always changing. Variable lake levels and weathering lead to shoreline erosion. Some of it is very gradual and nearly imperceptible; some can be rapid and catastrophic, as when a bank or bluff breaks apart and slumps downward.

The Bayfield County government is dedicated to protecting our Lake Superior shoreline and has actively supported research on coastal shoreline dynamics over the past several decades. Our goal is to provide objective scientific information to our community so that, together, we may chart the best future for this valued resource. Please refer to the following resources to learn more about Bayfield County's Lake Superior shore.


[ShoreViewer](#)
Close range, oblique aerial photographs taken of the entire Bayfield County shoreline in the Fall of 2002. These photos serve as a visual baseline of the shoreline condition and can be used for a variety of educational and planning activities.

[Oblique Photo Background and Highlights](#)
Detailed information about the shoreline imagery used in ShoreViewer

[Shoreline Profile Analysis](#)
A compilation of shoreline profile measurements collected by researchers at the University of Wisconsin-Madison which describes the nature and erosional tendencies of specific points along the shoreline. Accessible through ShoreViewer.

[Quick Guide to Lake Superior Shoreline Erosion](#)
An overview of the processes contributing to bluff erosion and descriptions of various types of bluff failures.

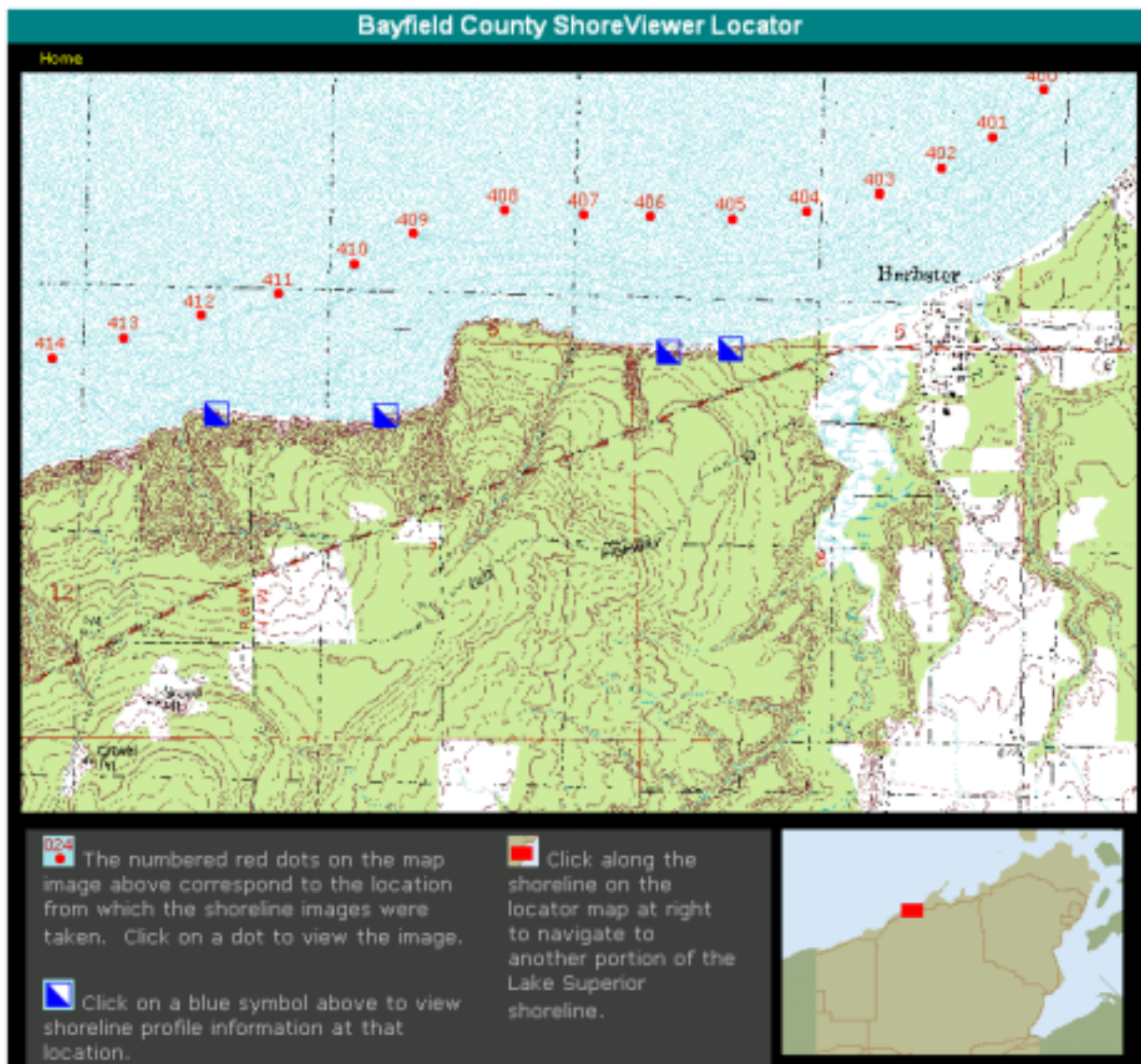
[Lake Superior Coastal Erosion Public Meetings](#)
An outreach session for sharing the latest research and information on Lake Superior coastal erosion. Sponsored by the Wisconsin Coastal Management Program.



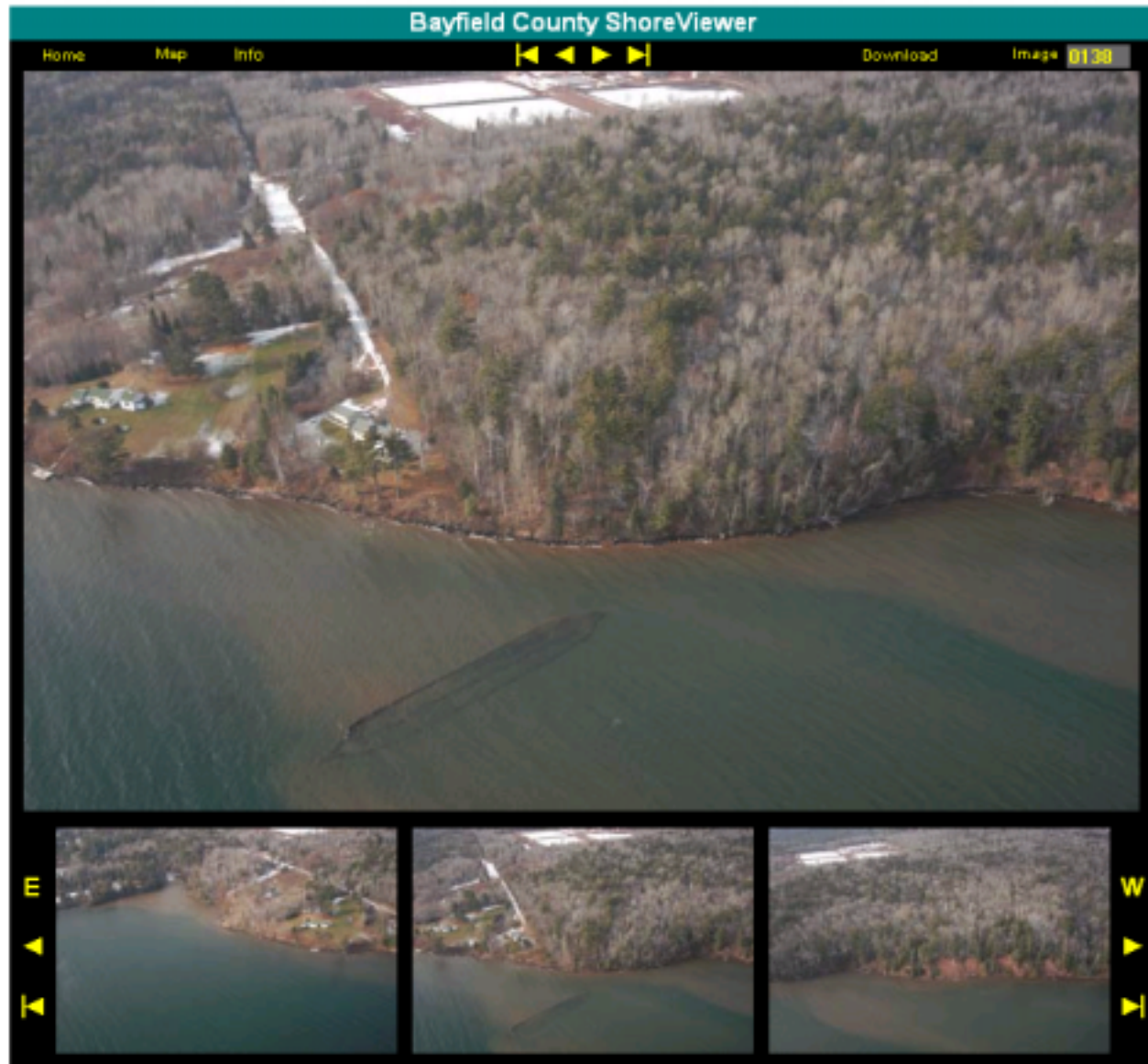
Click to view
ShoreViewer
Maps & Photos



ShoreViewer Locator Map



Example Oblique Photograph



Example Profile

Bayfield County ShoreViewer Profile Detail

Home Info

Profile	BA T48N 4W Sec 19/24 P3
Year Measured	2001
Latitude	46 37 00
Longitude	-90 55 55
Bluff Height (ft)	15
Nearshore Material	fine to med sand
Beach Material	sand, boulders
Seep Present?	no
Seep Location	
Bluff Material	Hanson
Vegetation Amount (%)	5
Vegetation Type	weeds, grasses

